

Popular Mechanics

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DECEMBER 1996

**GIANT
SPORT/
UTILITY
SHOOTOUT**

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P81

SCIENCE SOLVES THE ANCIENT MYSTERIES OF THE BIBLE

**BATTLE
OF THE
VIDEOGAMES**

Nintendo vs.
Sega vs. Sony
In Wild 3D
Action

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Popular Mechanics

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NO. 12

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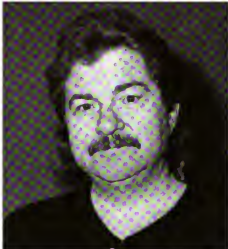
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EDITOR'S NOTES

● Like Charles Darwin's theory of evolution, the ancient mysteries of the Bible cause people to become very dogmatic. Points of view become very black-and-white. There is no middle ground, no hedging of position. You either believe or you don't. Thus, some people take the stories of the Bible literally, as detailed accounts of actual occurrences that took place in ancient times. Others see the stories in the Bible as fables, tales thrice told whose real importance lies in the deeper spiritual meaning of a story, not in a literal step-by-step chronicle or an eyewitness account. The naturally skeptical members of the scientific community have long had an interest in stories found in the Bible, not so much to say the incidents never happened but rather to offer what may be logical, nay scientific, explanations of some of these incidents. After all, not everyone possesses the blind faith needed to accept occurrences that defy logical reality. Some need more, an explanation that takes into account modern investigative technology, forensic science and a perspective of thousands of years. Thus, Mike Fillon, a contributor to POPULAR MECHANICS since 1983 and, by the way, vice president of the St. James Lutheran Church in his hometown of Norcross, Georgia, takes on the unenviable task of explaining what may have happened all those thousands of years ago to give rise to some of the more well-known stories from the ancient texts. As Fillon says, "Despite the heated debate raging in this country, particularly about creationism and evolution, science and religion are compatible. God gave us the ability to make scientific inquiries, and for many, the more they question, the more they see God's hand at work." In this holiday season late in the 20th century, it seems not blasphemous, but appropriate, to ask the question, "Can science solve the ancient mysteries of the Bible?" For the answer, turn to this month's cover story beginning on page 39. ... Finally we can report that just about all the news is in on the 1997 new car and truck front. Not only do we have part two of our report, which begins on page 44 and completes the report begun in the October issue, but we've also just put to bed the 1997 edition of the POPULAR MECHANICS *New Car & Truck Buyers Guide*. Look for it on your newsstands on December 10 or call our Reader Information Services Manager, Patty Woods (212/649-3127), to reserve your copy now. ... Did you know that the new digital cameras (page 63) allow you to take photos and make prints immediately right in your own home? They do and you can. ... If you're going to take your inept—or even expert—skiing skills to the slopes this year, you may want to know all about the new shaped skis (page 60) that make downhill racers out of mere mortals. Well, maybe I'm overstating their worth, but it's clear that the new technology makes any skier much, much better. ... With Sega, Nintendo and Sony battling it out (page 50) for videogame supremacy, isn't it nice to know that you can forget all about it, crank up your ultraconvenient gas fireplace (page 78) with a twist of a knob and curl up with this issue of POPULAR MECHANICS? Till next time.



Mike Fillon

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Joe Oldham

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frequent nighttime urination can...



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CARDURA®. The fast, easy treatment for frequent nighttime urination due to BPH.

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Cardura can cause a sudden drop in blood pressure at the beginning of treatment or if you miss doses and then start taking the medication again. You may feel dizzy, faint, or light-headed, particularly after getting up from a chair or bed. Speak to your doctor about oral medications like **Cardura** and other treatment options for BPH such as regular monitoring of the condition or surgery.

Please see important information on the next page.

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Read this information:

- before you start taking CARDURA®
- each time you get a new prescription.

You and your doctor should discuss this treatment and your BPH symptoms before you start taking CARDURA® and at your regular checkups. This information does NOT take the place of discussions with your doctor.

CARDURA® is used to treat both benign prostatic hyperplasia (BPH) and high blood pressure (hypertension). This information describes CARDURA® as treatment for BPH (although you may be taking CARDURA® for both your BPH and high blood pressure).

What is BPH?

BPH is an enlargement of the prostate gland. This gland surrounds the tube that drains the urine from the bladder. The symptoms of BPH can be caused by a tensing of the enlarged muscle in the prostate gland which blocks the passage of urine. This can lead to such symptoms as:

- a weak or start-and-stop stream when urinating
- a feeling that the bladder is not completely emptied after urination
- a delay or difficulty in the beginning of urination
- a need to urinate often during the day and especially at night
- a feeling that you must urinate immediately.

Treatment Options for BPH

The four main treatment options for BPH are:

- If you are not bothered by your symptoms, you and your doctor may decide on a program of "watchful waiting." It is not an active treatment like taking medication or surgery but involves having regular checkups to see if your condition is getting worse or causing problems.
- Treatment with CARDURA® or other similar drugs. CARDURA® is the medication your doctor has prescribed for you. See "What CARDURA® Does," below.
- Treatment with the medication class of α -reductase inhibitors (e.g. Proscar®). It can cause the prostate to shrink. It may take 6 months or more for the full benefit of finasteride to be seen.
- Various surgical procedures. Your doctor can describe these procedures to you. The best procedure for you depends on your BPH symptoms and medical condition.

What CARDURA® Does

CARDURA® works on a specific type of muscle found in the prostate, causing it to relax. This in turn decreases the pressure within the prostate, thus improving the flow of urine and your symptoms.

- CARDURA® helps relieve the symptoms of BPH (weak stream, start-and-stop stream, a feeling that your bladder is not completely empty, delay in beginning of urination, need to urinate often during the day and especially at night, and feeling that you must urinate immediately). It does not change the size of the prostate. The prostate may continue to grow, however, a larger prostate is not necessarily related to more symptoms or to worse symptoms. CARDURA® can decrease your symptoms and improve urinary flow, without decreasing the size of the prostate.
- If CARDURA® is helping you, you should notice an effect within 1 to 2 weeks after you start your medication. CARDURA® has been studied in over 900 patients for up to 2 years and the drug has been shown to continue to work during long-term treatment.

Even though you take CARDURA® and it may help you, CARDURA® may not prevent the need for surgery in the future.

- CARDURA® does not affect PSA levels. PSA is the

abbreviation for Prostate Specific Antigen. Your doctor may want a blood test called PSA. You may want to ask your doctor more about this if you have had a PSA test done.

Other important Facts

- You should see an improvement of your symptoms within 1 to 2 weeks. In addition to your other regular checkups you will need to continue seeing your doctor regularly to check your progress regarding your BPH and to monitor your blood pressure.
- CARDURA® (doxazosin mesylate) is not a treatment for prostate cancer. Your doctor has prescribed CARDURA® for your BPH and not for prostate cancer; however, a man can have BPH and prostate cancer at the same time. Doctors usually recommend that men be checked for prostate cancer once a year when they turn 50 (or 40 if a family member has had prostate cancer). A higher incidence of prostate cancer has been noted in men of African-American descent. These checks should continue even if you are taking CARDURA®.

How To Take CARDURA® and What You Should Know While Taking CARDURA® for BPH

CARDURA® Can Cause a Sudden Drop in Blood Pressure after the VERY FIRST DOSE. You may feel dizzy, faint or "light-headed," especially after you stand up from a lying or sitting position. This is more likely to occur after you've taken the first few doses or if you increase your dose, but can occur at any time while you are taking the drug. It can also occur if you stop taking the drug and then restart treatment. If you feel very dizzy, faint or "light-headed" you should contact your doctor. Your doctor will discuss with you how often you need to visit and how often your blood pressure should be checked.

Your blood pressure should be checked when you start taking CARDURA® even if you do not have high blood pressure (hypertension). Your doctor will discuss with you the details of how blood pressure is measured.

Blood Pressure Measurement: Whatever equipment is used, it is usual for your blood pressure to be measured in the following way: measure your blood pressure after lying quietly on your back for five minutes. Then, after standing for two minutes measure your blood pressure again. Your doctor will discuss with you what other times during the day your blood pressure should be taken, such as two to six hours after a dose, before bedtime or after waking up in the morning. Note that moderate to high-intensity exercise can, over a period of time, lower your average blood pressure.

You can take CARDURA® either in the morning or at bedtime and it will be equally effective. If you take CARDURA® at bedtime but need to get up from bed to go to the bathroom, get up slowly and cautiously until you are sure how the medication affects you. It is important to get up slowly from a chair or bed at any time until you learn how you react to CARDURA®. You should not drive or do any hazardous tasks until you are used to the effects of the medication. If you begin to feel dizzy, sit or lie down until you feel better.

- You will start with a 1 mg dose of CARDURA® once daily. Then the once daily dose will be increased as your body gets used to the effects of the medication. Follow your doctor's instructions about how to take CARDURA®. You must take it every day at the dose prescribed. Talk with your doctor if you don't take it for a few days for some reason, as you may then need to restart the medication at a 1 mg dose, increase your dose gradually and again be cautious about possible dizziness. Do not share CARDURA® with anyone else, it was prescribed only for you.
- Other side effects you could have while taking CARDURA® in addition to lowering of the blood pressure, include dizziness, fatigue (tiredness), swelling of the feet and shortness of breath. Most side effects are mild. However, you should discuss any unexpected effects you notice with your doctor.
- Keep CARDURA® and all medicines out of the reach of children.

FOR MORE INFORMATION ABOUT CARDURA® AND BPH TALK WITH YOUR DOCTOR, NURSE, PHARMACIST OR OTHER HEALTH CARE PROVIDER.

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LETTERS

Sense And Sensibilities



What an idiotic, stupid stunt! Driving 113 mph on a public highway with thousands of innocent citizens on the same road. That's 2486 ft., almost half a mile, in 15 seconds. What happens if a deer jumps up from the wayside? What happens if a tire blows? What happens if an RV pulls out to pass a triple-long tractor trailer? What happens is death.

EARL A. STANEK
SARASOTA, FL

And what if nothing happened, except that people found out that good drivers in well-maintained vehicles can travel safely at high rates of speed on our interstate highway system?
—Ed.

I liked your article "Montana Run." Did you know that you can drive those same speeds in Maryland on I-95 and I-695?

JAMES SARRIF
BALTIMORE, MD

Your article is a dangerous piece of immature hype that encourages leadfoots and is a poor representation of Montana's speed limit. As your article stated, we have a speed limit

Letters are subject to editing for length, style and format.

here, The Basic Rule, which means driving on our highways should be reasonable and prudent. This law was enacted because our state is so large that traveling long distances is common and time-consuming. Abuse of the law can only lead to problems for all of us.

GARY D. KNOPP
VIA INTERNET

You and many other readers missed the whole point of the article. Our editors went to Montana to investigate whether Montanans had changed the way they drive since the passage of the new law, and whether drivers—either state residents or transients—had made Montana a lawless state, if you will. Obviously, neither happened, proving once again that Americans are smarter than politicians give us credit for. I'm convinced that The Basic Rule could work on all our interstates. —Ed.

I really take offense to your cavalier attitude toward a safety issue. TED LORENZ
VIA INTERNET

In one article, you've managed to offend the sensibilities of granola crunchers, cops and bug lovers. As a former writer for *National*

Lampoon, I can list a few items that P.J. O'Rourke would have insisted upon in the upper photo on page 50. The guy in the white shirt would be replaced by a babe in a bikini ripping up a photo of the Pope. The guy in the red shirt would be smoking a cigarette and holding a .44 magnum revolver. The Yellowstone National Park sign would be riddled with bullet holes. And there would be a spotted owl smeared across the grillwork of the Pontiac Trans Sport Montana. Aside from those minor quibbles, it was a pretty good piece. JIM WILSON
NEW YORK, NY

If you need to do another 90-plus-miles-per-hour test

for a vehicle, take it to a track, where the only lives your journalists can risk are their own.

ERIC DURKIN
BUTTE, MT

To find out that the Trans Sport Montana will go 113 mph and average 6 mpg is about the most useless information I can think of. Don't waste time writing for the 1% lunatic fringe that wants to drive fast and learn about the Montana police.

WALTER L. MOSER JR.
MAYVILLE, MI

What was the point here? That it's possible to drive like a fool and survive?

JOHN WILEY
PORT JERVIS, NY

Advertisement

Reader Project Of The Month

STANLEY



Your Home Improvement Guide (page 79, April '96) helped me solve the problem of how to incorporate bookshelves into our family room. I combined two of the projects to produce a wall-to-wall bookcase. I installed wainscoting under the shelves because of space considerations that won't allow cabinets.

KEVIN SCHOENECKER
LITTLETON, CO

If your project is chosen as Reader Project Of The Month, you will receive a Stanley Home Improvement Kit, complete with hand and decorating tools, and an electric stapler/nailer, valued at more than \$200. For your project to be considered, please send a clear, color photo and brief description to: Reader Project Of The Month, Popular Mechanics, 224 W. 57th St., New York, NY 10019.

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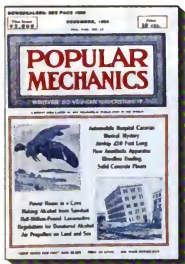
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TIME MACHINE

90 YEARS AGO: DECEMBER 1906



Insect Aircraft

Naming an aircraft after an insect is unusual, but what about designing a plane to look like a bug? Our European correspondent spotted a model of just such a plane on display in Brussels. It was built by members of the Aero Club of Belgium. As far as we know, a passenger model never flew. Perhaps it is just as well. See the four vertical strips on the tail? They are not decorations but segments of the airbag that served as the landing gear.

House Calls

At the beginning of the century, when doctors viewed treating the poor as a professional duty rather than a governmental responsibility,

physicians routinely participated in mercy missions. We reported on one such effort to prevent blindness in Egypt. While traveling in a motorized caravan and



living in tents for months at a time, a team of volunteer doctors treated nearly 19,000 patients. The accompanying photograph showed their open-air operating room.

60 YEARS AGO: DECEMBER 1936



Trans-Atlantic Travel

Aviation experts showed off plans for a 500-passenger flying boat. After a 5-mile takeoff roll, it would climb to 10,000 ft. and cruise at 300 mph, crossing the Atlantic Ocean in 11 hours. Today, almost everyone knows that jet engines eventually made this dream a reality. But few know that radar halved the number of jobs for pilots. It eliminated the need for "pilot planes" that flew ahead and cleared routes for the lumbering beasts.

Home To Go

As they pulled off the sales lot, drivers realized there might be a problem with the trailers that had become the latest motoring fad. Their size completely obliterated rear visibility. We presented one trailer manufacturer's clever solution: a fold-down mobile home.

The 13-ft. model that we featured in our photo spread offered vacationers two beds, a water tank and a kitchen with rudimentary appliances and a table.



30 YEARS AGO: DECEMBER 1966



Disney Christmas

With the Small World attraction the big hit of the New York World's Fair, it seemed only natural to show PM readers how to tap into the Walt Disney magic to create yard decorations for Christmas. Fred MacMurray, then starring in the Disney movie "Follow Me, Boys," helped us show our readers how to construct a free-standing holiday mobile. The ornaments? Who else but Mickey Mouse, Donald Duck, Pluto, Bambi and Dopey.

Wings Of Man

We recounted British efforts to win the Kremer Prize for manpowered flight. However, the prize wasn't collected until nine years later, when it was won by the American Gosamer Condor. Had there been an award for strangest-looking entry, it might have been won by this 13-wheel contraption, which never left the ground. **PM**



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OUR BOATS FEATURE A UNIQUE

COMBINATION OF STYLING,

PERFORMANCE AND HANDLING,

UNLIKE ANY OTHER WATERCRAFT

ON EARTH. FOR '07, WE'VE

CREATED A LINE OF HIGH-TECH,

HIGH-PERFORMANCE BOATS

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THEY'RE FUN TO OWN.

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SWORN TO FUN.**



SEA-DOO®
EVERYONE'S JOINING IT™

*Whether you deliver
victory or celebrate it,
the smooth relaxing taste
of a Garcia y Vega® cigar
comes through every time.*

Here's to those extraordinary few who deliver on their promises.

The promise of extraordinary taste.



Since 1882.



*Receive a free lighter and great outdoor items in the Garcia y Vega Collection.
Look for specially marked packs at participating stores.*

TECH UPDATE

News Of Tomorrow's Technology Today



TM ILLUSTRATION BY PAUL DIAMME

Old Bridges Eyed As Future Fueling Stations

PORT EWEN, NY—If you live near water, you probably know of an old bridge no longer in use that looks like it's teetering on its last legs.

Where most people see rusting relics and eyesores that attract vandals, energy consultant Robert J. Dederick sees opportunities to free America from fossil-fuel dependence.

Dederick wants to convert derelict bridges into a network of free-standing energy stations. Similar to today's gas stations, they would sell nonpolluting fuels for the coming generation of zero-pollution vehicles.

Why bridges? Dederick says their locations typically make them perfect sites for solar panels and wind turbines. Bodies of water are notably lacking in obstructions that block the sun and wind. Bridges over fast-flowing streams or near shore areas are ideal anchor points for hydroelectric,

tidal-flow and wave generators.

Dederick's plan is to use the electricity generated by these nonpolluting devices to electrolyze water into its constituent oxygen and hydrogen. The oxygen could be bottled and sold locally to welders and hospitals, among others. The hydrogen could be used by cars that have been converted to run on the gas, or by fuel-cell-powered electric vehicles, such as future production models of Daimler's experimental NECAR II van (see

An artist's conception of the Jamestown Bridge in Rhode Island, after conversion into an energy station.

Tech Update, page 15, Oct. '96). In addition, when the technology arrives, it could be used in hydrogen-powered boats as well.

Facing dismantling bills that in some cases could equal or exceed original construction costs, bridge owners are taking Dederick's plan seriously. He says he is currently negotiating with five local and state governments.

Highlights This Month

- **Solar Speedboat**—Skimming the waves with solar cells.
- **Muscle Cars**—Student designers flex their imaginations.
- **Sub Recovered**—German U-boat floats to British dock.
- **Mine Blower**—Swedish robot explodes underwater killers.
- **Zapped**—Million-volt transformer built from circuit boards.
- **Farnborough '96**—Flubbed maneuver limits Russian jet.
- **Hingeless Helicopter**—Electric current bends blades.

Editor/Writer: Jim Wilson
Reporters: Sherri Eisenberg, Kathleen Gleaves,
Barry Rosenberg, Andy Turnbull



Solar Boating Gaining Its Sea Legs

MILWAUKEE, WI—Here's an idea destined to make a splash in lake and riverfront communities that are cracking down on motorboats: solar speedboats.

Obviously, their performance has a long way to go before it matches that of motorboats, but this year's Solar Splash Boat Race proved that the

technology is gaining its sea legs.

Japan's Kanazawa Institute of Technology took honors as the Collegiate World Champion, scoring an 893 out of 1000. Points were awarded based on performance in speed and endurance trials. The University of Michigan won the sprint event, completing a 300-meter course in 25.73 seconds.

The Michigan entry won the sprint event. Students from 15 colleges participated. Battery, motor and beer makers and engineering societies sponsored the contest.

The University of Massachusetts boat chugged along for 18.6 miles on direct solar energy and two small car batteries to win the endurance competition.

There are faster ways to travel than solar boats, but at least you can tap the battery to power the beer chiller.

A Stew Over Mad Cows



Scientists can't explain how cows pass BSE to their calves.

LONDON, ENGLAND—British scientists and cattle producers have a beef about beef. It centers on bovine spongiform encephalopathy (BSE), also known as mad cow disease.

European countries banned British beef after studies suggested eating meat from BSE-infected animals might induce dementia in humans—as long as 10 years after ingestion.

British government officials say the problem peaked in 1992 with 36,681 confirmed cases. Fewer than 4000 new cases were reported through this summer. French and Swiss scientists say they don't believe the numbers and advocate massive cattle kills. Also, all of the mathematical models of the disease's future were recently thrown into question by the discoveries that BSE can pass from cows to calves and perhaps to sheep.

The good news for American hamburger lovers is that mad cows haven't crossed the Atlantic.

Crystal Ball 3D Display

STANFORD, CA—A doodle sketched by a Stanford University graduate student has given the entertainment industry a glimpse of the future of 3D projection.

Elizabeth Downing's novel 3D display uses scanners from surplus optical-disc players to trace two infrared laser beams through a transparent cube that contains light-emitting impurities. Where the two beams intersect, their combined energy causes the impurities to emit a burst of red, blue or green light. The eye sees the illusion of a color image.

The idea isn't entirely new. Researchers at Battelle Memorial Institute, in Columbus, Ohio, tried without success to develop a simi-



Downing says projecting a 3D image requires 500 times as much data as displaying it on an ordinary screen.

lar device in the early 1970s.

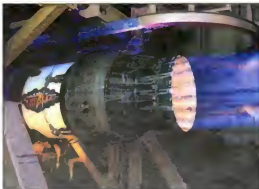
Unless you're sitting on a fat wallet, don't throw away your funny-looking 3D glasses just yet. Downing's display is only the size of a cube of sugar, and she estimates that building a 10-in. prototype will cost about \$80,000.

Hot New Engine For Fighters

WEST PALM BEACH, FL—Pratt & Whitney has taken the wraps off its next-generation engine for F-15 and F-16 fighters.

Called the PW-229A, it applies a series of innovations developed for the engine in the Air Force's next fighter, the F-22.

Chief among these improvements is an 11-segment high-turbulence augmentor. It incorporates a new



PW-229A engine has been tested for 400 hours, including 40 hours of operation on afterburner.

fan design that more uniformly mixes fuel and eliminates engine hot spots. For pilots this will mean faster transitioning: from idle to maximum afterburner in about 2 seconds, then back to idle in 1 second.

Maintenance crews should like the engine too. Its new 1-piece inlet case replaces the entire compressor-inlet vane system, eliminating about 300 parts, compared to current PW-229 engines.

Pratt & Whitney says it can put the PW-229A engine into production by as early as 1998.

Herbert Hart
Auto and Truck Mechanic
Los Angeles, CA

Convincing Herb to try our tools for 90 days wasn't easy.

"Why should I give up the tools I trust?" he asked.

We told him ours were guaranteed forever.

"Leave the tools. I'll give 'em a shot."

Three months later, we came back.

"I thought I got rid of you guys," he said.

We reminded him we loaned him our tools.

Herb said, "This is my garage. Now these are my tools."

Okay, Herb whatever you say.



HUSKY®

The toughest name in tools. Only at The Home Depot.

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Generation-X Muscle Cars

PASADENA, CA—What comes to mind among members of the X generation—raised mostly in econoboxes and minivans—when they hear the phrase “muscle car”?

Chrysler product designer Bob Boniface found out when he challenged students at the Art Center College of Design to create new street stompers for these times.

“Chrysler Corp. hasn’t built a muscle car since the early 1970s,” he told the would-be car designers. “Your assignment is to combine the performance and excitement of the 1960s muscle cars with the innovative packaging philosophy of today’s Chryslers.”

Like the muscle cars of old, the proposed models present bold grille designs and shapes that make them appear to be speeding even when standing still. Although Chrysler’s

Super Bee, Road Runner and Hemicuda went out of production before most of the student designers were born, their work shows that the basic muscle-car instinct remains undiminished.

One thing, however, was very different. The students did most of their creative work using computer workstations instead of pads and pencils.

Top designs included those from (clockwise from top left) Toshio Stehnenberger, Dong Jin, Ha Hak Soo and Greg Hathaway.



Keeping Snowmobiles On Ice

TORONTO, CANADA—When two University of Waterloo engineering students learned that about half the 100 deaths in snowmobile accidents last year occurred by drowning, they saw an opportunity to do well by doing good. They developed a flotation system that deploys when the machines break through thin ice.

Three bags—one under the nose and one under each running board—inflate with high-pressure carbon dioxide about 2 seconds after water rises past a

preset level. The delay prevents accidental inflation while crossing streams and deep puddles. The bags can also be inflated manually. Flotation bags should also be welcomed by water racers, who skim high-speed snowmobiles over miles of open water or around circular tracks.

Developers Hugh Downey and Rob Stephenson hope the flotation system, which has already won a provincial design award, will become optional equipment on all new snowmobiles.



The snowmobile flotation system can support the driver and one passenger.

Concrete Doors

RALEIGH, NC—Where wood is scarce and the weather is harsh, finding the right front door can pose quite a challenge.

Christos Saccopoulos, head of the architecture department at North Carolina State University, faced this very problem when he built a vacation house on an isolated beach in Greece. Almost immediately, the wood front door and its frame began rotting.

Working with colleague Frank Harmon and textile researcher Mansour H. Mohamed, he perfected a door that could change the look of Mediterranean architecture. The door is made from a light-aggregate concrete mix, reinforced with 1-in. glass fibers. In place of a pair of hinges, the door swivels on pivots. Openings for locks, knobs and glass are created when the door is cast.

The current model weighs 200 pounds, two-thirds that of early models, but it’s still not anything you would want to bump into in the dark.



Co-developer Harmon with the latest version of ready-to-install concrete door.



It's full
of surprises.





You can opt for a premium InfinitySM stereo system with cassette and CD player in the new Dodge Dakota. Eight speakers in six locations kick out some real concert-quality sound.



We gave the new Dodge Dakota quick-ratio, variable-assist power steering, for speedy response and a solid feel.



The new Dodge Dakota offers a choice of Magnum[®] engines: a gutsy standard four cylinder, a powerful V-6, or a 230-horsepower V-8—the only V-8 in the class. Now that's a lot of juice.



The large, well-illuminated speedometer and available tachometer dials are real easy-to-read. Plus, the instruments are controlled by a microprocessor, for optimum accuracy.



High-strength steel door beams give you the feeling of being in a real secure place.



We call it cargo. You call it stuff. Whatever you call it, there's more room for it in the new Dodge Dakota than in any other truck in its class.



Once again, Dodge opens new doors for Dakota owners. This time, with available remote keyless entry.



Its new frame has terrific torsional rigidity. The upshot: The all-new Dakota has the strength you demand from a truck, and the cornering predictability you might expect of a sports sedan.

Power



- Dakota offers a standard I-4, a V-6, and the only V-8 in the class.
- Dakota has more available horsepower.
- Dakota has more available torque.
- Dakota has more standard horsepower.
- Dakota has more standard torque.

Ride & Handling

- Dakota has a longer wheelbase, which makes for a smooth ride.
- Dakota's turning circle is smaller than Ranger's and S-10's short wheelbase and Club Cab 2WD models.
- Dakota has a wider track, which enhances stability.

Dodge Dakota

5.2L V-8
H.P. 230 @ 4400 rpm
Torque 300 @ 3200 rpm
2.5L I-4
H.P. 120 @ 5200 rpm
Torque 145 @ 3250 rpm

(SWB/Club Cab)
112.0"/130.9"
36.0"/41.2"

Front/Rear
2WD 60.5"/61.5"
4WD 60.8"/61.5"

Ford Ranger

4.0L V-6
H.P. 160 @ 4200 rpm
Torque 220 @ 3000 rpm
2.3L I-4
H.P. 112 @ 4800 rpm
Torque 135 @ 2400 rpm

(SWB/Club Cab)
107.9"/125.4"
36.5"/41.6"

Front/Rear
2WD 56.6"/57.3"
4WD 58.3"/57.3"

Chevrolet S-10

4.3L V-6
H.P. 190 @ 4400 rpm
Torque 250 @ 2800 rpm
2.2L I-4
H.P. 118 @ 5200 rpm
Torque 130 @ 3200 rpm

(SWB/Club Cab)
108.3"/122.9"
36.9"/41.3"

Front/Rear
2WD 55.0"/54.6"
4WD 57.2"/55.1"

Comfort & Convenience



- Dakota has a roomier interior.
- Club Cab
- Regular Cab
- Dakota is the only one to offer a 40/20/40 split bench seat with mini business console.

Safety Features

- Dakota is the only one with standard dual airbags.*
- Dakota is the only one to offer a self-dimming rear view mirror.
- Dakota offers bigger exterior mirrors, for a larger field of vision.

Dodge Dakota

84.7 cu. ft.
56.4 cu. ft.
40/20/40 split bench

Standard dual airbags

Available

50.0 sq. in.

Ford Ranger

66.3 cu. ft.
52.5 cu. ft.
Not available

Optional dual airbags

Not available

31.5 sq. in.

Chevrolet S-10

65.3 cu. ft.
55.6 cu. ft.
Not available

Driver's airbag only

Not available

41.0 sq. in.

Towing & Payload

- Dakota has 800 lbs. more available towing.
- Dakota has over 900 lbs. more available payload.
- Dakota has a larger bed.
- Dakota long bed holds 4"x8" building materials with the tailgate closed.



Dodge Dakota

6800 lbs.
2600 lbs.

Short Bed
Length: 77.9"
Width: 57.8"
Depth: 17.5"
Volume: 46.5 cu. ft.

Long Bed
Length: 96.4"
Width: 57.8"
Depth: 17.5"
Volume: 56.4 cu. ft.

Ford Ranger

6000 lbs.
1650 lbs.

Short Bed
Length: 71.8"
Width: 54.4"
Depth: 16.5"
Volume: 37.4 cu. ft.

Long Bed
Length: 83.8"
Width: 54.4"
Depth: 16.5"
Volume: 43.5 cu. ft.

Chevrolet S-10

6000 lbs.
1502 lbs.

Short Bed
Length: 72.8"
Width: 54.9"
Depth: 17.1"
Volume: 39.4 cu. ft.

Long Bed
Length: 88.8"
Width: 54.9"
Depth: 17.1"
Volume: 48.1 cu. ft.

*Always wear your seat belt for a fully effective airbag. Rearward-facing child seats cannot be used in standard cab models. Comparisons vs. Ford Ranger and Chevy S-10. Information based on data available at time of printing. †See limited warranty & restrictions at dealer. Excludes normal maintenance and wear items.

Paper contains ten percent recycled material. ♻️



Club Cab Sport 4x4

Sport 4x2

The New Dodge Dakota



British Rescue No-Loot U-Boat

BIRKENHEAD, ENGLAND—Ever since the Nazis surrendered, rumors that they had spirited away a king's ransom in gold and jewels aboard U-boats have tantalized treasure hunters. Three years ago, divers cracked the hatch on the last good candidate, the U-534, a type IXC submarine that was sunk on May 5, 1945, off the coast of Denmark.

But there was no treasure aboard, and the U-534 nearly ended up in a scrap yard. However, earlier this year the Warship Preservation



PHOTO BY AP/WIDE WORLD PHOTOS

Experts attribute the U-534's excellent condition to her having been buried in soft mud.

Trust rescued the sub and had it barged up England's River Mersey to a converted warehouse in Birkenhead,

30 miles from Liverpool. The Trust plans to make the German submarine the featured attraction at a museum.

Radio-Controlled Winner

NEW YORK, NY—In our 1958 Christmas issue we introduced our readers to Radicon, the world's first remote-controlled toy robot. As this issue went to press, Sotheby's, the world-famous auctioneers of fine art and antiques, informed us that this ground-breaking toy was about to go on the block.



SOOTHEBY'S INC. PHOTO

Radicon will fetch a premium price partly because the first owner kept the box.

Stunning for its day but primitive by contemporary standards, Radicon follows radio-transmitted commands to move forward and back, turn and flash its lights. According to Sotheby's, it is now one of the rarest, and most expensive, toy robots in existence.

With bidding on Radicon expected to reach \$15,000, the moral is clear: Take good care of your toys.

Paris Subway Automates

PARIS, FRANCE—Something is missing from the plans for this city's next subway trains—seats for drivers.



RMT COMMUNICATIONS PHOTO

The first driverless trains will run on the Météor Line in 1998.

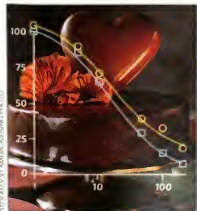
Driverless trains now under construction will use a redundant computer system to operate doors, power and braking. Second-by-second performance data will be sent to a control center via a track coupling. Down-the-track video views will be transmitted via a wireless link. If a train is delayed, the central computer will adjust the speed of those following it.

Automated trains will do more than eliminate the need for subway train drivers. Their redundant controls and maintenance-assistance systems will make it possible to operate the line with 52 trains instead of 57.

Psycho-Choco Reaction

SAN DIEGO, CA—Not long after he begins shaving, a young man learns that a box of chocolates can earn forgiveness for a multitude of sins.

Researchers at The Neurosciences Institute believe they know why. Danielle Piomelli and her colleagues say they have found three compounds in chocolate that are structurally similar to anandamine. This naturally produced brain chemical stimulates the same nerve cells as does the active ingredient in marijuana.



THE NEUROSCIENCES INSTITUTE PHOTO

The exact reason why this happens has yet to be determined. However, Piomelli's team can offer this shopping hint: Avoid white chocolate as a peace offering. It lacks the psychoactive ingredient that gives regular chocolate its charm.

Compounds in chocolate appeal to the same part of brain as cannabinoid drugs.



Fast Data For Air Racers

SEVERNA PARK, MD—One FDAS flight teaches pilots a year's worth of seat-of-the-pants flying. Telemetry developed for the military will soon make Formula One air racing more exciting and more accessible to television audiences.

The Flexible Data Acquisition System (FDAS) was developed by Beta Motor Sports and is currently installed on the Nemesis racer. It collects pilot, aerodynamic, airframe and engine-performance data as the 200-cu.-in. engine planes race one another around a 3-mile oval.

Analyzing this information on a Macintosh computer can show crews and pilots how to improve their techniques. Coming soon: FDAS video for commercial broadcast.

WING PRODUCTION PHOTO/ERIC TEELE PHOTO

Exploding The Oldest Mines

KARLSKRONA, SWEDEN—As long as their locations remain unknown, old-fashioned underwater contact mines are a threat to even the stealthiest of minesweepers.

To prevent its warships from falling victim to these aging devices, the Swedish Navy plans to equip its latest minesweeper, the *HMS Stryx*, with an underwater-mine hunter.

Called the *Double Eagle*, the submersible is propelled and steered with six electric motors. Normally, it swims ahead, following a route stored in the *Stryx*'s tactical data system.



When *Double Eagle*'s Super-VHS camera or ultrasensitive sonar detects a mine, it sounds an alert and turns over the controls to a human operator. He can steer it in for a closer look, and then destroy a mine by releasing an explosive.

It is anyone's guess as to how many old underwater contact mines remain active. Sutech, the Bofors Underwater Systems subsidiary that developed *Double Eagle*, believes there are enough mines to make its unique, relatively low-tech detection system a must-have item for all the world's high-tech navies.

A computer-controlled winch maintains proper tension on *Double Eagle*'s neutral buoyant leash, which contains power and communications lines.

Seeing Through The Fog



PORTLAND, OR—Wintertime flying in the Pacific Northwest usually means three things: fog, fog and more fog. While other carriers' planes have to circle socked-in airports or are diverted, Alaska Airlines keeps its takeoffs and landings right on schedule.

Its secret weapon is the Fog Buster, a head-up guidance system that allows manual and instrument takeoffs in as little as 300 ft. of visibility, and landings in as little as 700 ft. of visibility.

Built by Flight Dynamics, the Fog Buster consists of a projector mounted behind the pilot's head. It beams necessary flight data, an outline of the runway and a bull's-eye landing target on a flip-down glass screen directly in the pilot's line of sight.

Alaska Airlines paid \$12 million for its Fog Buster system. The airline believes that the savings from avoiding delays will pay for the technology in two to three years.



Display swings out of the way during clear weather.

A Million Takeout Volts

ONTARIO, CANADA—It isn't so hard to build a 1-million-volt power supply. The challenge is making it stable to within 0.5%. And the really hard part is fitting it into a space that is smaller than a minivan.

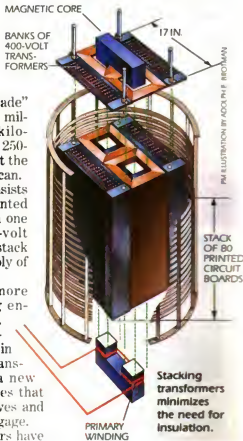
James Cross of the University of Waterloo says the solution is to think small. His new "cascade" transformer packs 1 million volts and 30 kilowatts of power in a 250-pound package about the size of a large trash can.

Cross's device consists of a stack of 80 printed circuit boards, each one containing 32 400-volt transformers. The stack puts out a total supply of 1,024,000 volts.

The project is more than a challenging engineering exercise. Airline security experts are interested in using the Cross transformer to power a new generation of devices that can identify explosives and drugs hidden in baggage.

Now that designers have

the ability to package so much well-regulated power in so small a place, expect to see downsizing of devices from radar transmitters to food pasteurization systems.



[illegible]

Great New Products



Russian astronomers fold super-power reflecting scope into 7 1/2 inches!

The world's most powerful telescopes use giant reflecting mirrors to fold the light path, so they can range billions of miles to the very edges of the universe. Astonishing new Cat-Scope not only miniaturizes these celestial explorers, but folds the light path *twice*. You enjoy the power of cannon-sized scopes right in the palm of your hand!

Enormous 20x magnification and superb low-light performance. Study rock formations on the moon, or read lips a ball field away. Oversized objective lens and precision-coated lens system give you *hairline* definition. Focus from infinity to as close as 10 yards! Rubber armor-coating takes the abuse and moisture that lesser scopes can't. Busting, nature study, astronomy, hiking, concerts, or sports events - the release of top-secret space-race technology now gives you unequalled observation and surveillance power. At a fraction of its true value.

■ Dual-Reflecting Armored 20x Cat Scope, #BC-500 \$89.95

Weights just 13.6 oz. Measures 7 1/2" x 2 1/2". Complete with lifetime warranty.

Take back control of your telephone.

Tele-Screen™ Phone Protector eliminates unwanted calls. Harassing calls, sales calls, any call you wish. Incoming calls are greeted by a voice prompt: "Thank you for calling. Please enter the four-digit pass-code." Your phone rings only if the caller enters the correct code. Voice prompt repeats and if no code is entered, the caller is automatically disconnected! Use the keypad to change the code, or de-activate the unit. Also secures fax and modem lines!

■ Tele-Screen™ #TS-300 \$44.95

Install in less than an answering machine, with its own AC power pack. Rings once to let you know it's working. Lets un-TeleScreened extensions still ring.



Hear the teeming rainforest of your own backyard.

The sound amplifier you may have heard about. Whisper 2000 captures even far-away sounds, and delivers them to you, crisply and clearly. Great for nature study, security, even watching TV. Built-in volume lets you adjust for sensitivity. Complete with ear-phones and our no-risk guarantee.

■ Whisper 2000 Sound Booster #W-2000 \$18.95



The Grundig Roltronic

From German engineers, the Porsche Turbo of electronic shavers.

This is the world's best, bar none. Click the switch - no whine, no vibration. Just the low purr of a powerful engine. The shave you'll experience something totally new:

A two-day growth melts away in a pull, no scrape, no effort. This *hair-cutting* effortless shave is brought to you by the world's first *combined* horizontal and rotary cutting system. The ultra-tech honeycomb cutter hides in an astonishing *40-micron* thin platinum-coated screen. Your skin is protected at every angle, yet whiskers seem to be forever gone.

Use it corded or cordless. New hybrid batteries charge fast, plus have longer life for on-the-road shaves. LCD shows power reservoir. Trimmer even slides out for mustaches or sideburns. Take one out for a test shave. Your old shaver will begin to look like a rusty trowel.

■ The Grundig Roltronic Shaver, #GR-2010 \$259.95

Complete with mirrored travel case, for on-the-run shaves. Look your best anywhere.



Extra! Extra! Lindbergh flies NY to Paris in 33 hours! Crowds roar!

Owning the radio that guided a true American hero on his record breaking solo flight. Updated with powerful digital sound, and a side-port cassette deck. Flip the toggle switches. Tubes come to life with an amber glow. Turn off your room lights and tune in your favorite music or news, AM or FM, on the lighted main dial. Or slip in a cassette. Authentic recreation also has individual volume/tone knobs, swiveling oval-coil antenna, and bottom drawer stash, just like the original! Real wooden case is beautifully polished. AC powered. Lifetime warranty.

■ The Spirit of St. Louis Wireless Valve Radio, #1927-R \$99.95



Drive a 13mph Abrams tank.

A combat-tested dynamo. Now you take the controls. Husky 1/20th scale version grinds over impossible terrain, fords streams, even claws its way up 45° slopes! 2-channel dual-sock remote operates left/right treads individually - spin 360° instantly! Speeds up to 13 mph, 4x faster than a quick walk!

Electric engine roars 8 to 10 minutes before you even need to recharge. Rotate the turret, elevate the gun and send one up your neighbor's driveway! Complete with controls, battery pack, and recharger, all ready to roll!

■ Abrams M1A1 Radio Controlled Battle Tank, #10775 \$149.95.

App 13" x 6".

Real M1A1 Abrams Battle Tank at 1/20th Scale.

Goat 13mph!

Rips through sand, ice, grass, standing water - even up 45° inclines!



Satisfaction Guaranteed or Your Money Back.



EDGE NIGHTHAWK PISTOL CROSSBOW



- Nighthawk Pistol Crossbow #1066 \$29.95
- 12-pack extra PVC/steel bolt-arrows. #1066-12 \$4.95
- Dalsec Electronic Red-Dot Point Scope #780902 \$18.95

Have you ever gone target shooting with a crossbow? Slide a steel-tipped bolt into position, take aim, and pull the trigger! A 100 mph thrill, especially when you hit the target dead-on. Includes the die-cast alloy 40lb. draw Nighthawk, bow string, and 5 bolt arrows. Test fire yours today.



Cyclone-power coin bank sorts, counts, and wraps – all with see-through action!

Drop a cascade of coins down the chute. Click the switch. Watch as pennies, nickels, dimes, and quarters whirl, spin and fall neatly into their proper channels – and right into the waiting coin wrappers! Built-in coin vault stores excess, lets you know anytime how much you've saved. Runs on 2 "C" batteries, not included. A blast to watch, and a fun way to save.

- Easy-Money™ Turbo Coin Machine, #EZM-20 \$29.95
Complete with starter pack of coin wrappers.
- Easy-Money Optional AC Adaptor, #EZ-A \$9.95

Don't curse useless matches and cheap lighters. Get guaranteed fire, indoors or out!

Anywhere. Anytime. Just click the ball-switch of the new Silver Streak Pencil Torch. Instantly you control a reaching pin-point blue-hot flame – over 2,500°, twice that of ordinary torches! Bend glass, solder electronics, braze plumbing, cut rope like a laser beam, or start a campfire in a moonsoon. Only 6" long, with a 30 minute fuel reservoir. Fully adjustable. Includes stand for two-way hands-free use.

- Silver Streak Electronic Pencil Torch #PTS000-S \$29.95

Electronic ignition – no flints or strikers! Pocket size.

Hobbies • Electronics • Outdoors • Plumbing
Wood Burning • First Aid • Survival



Detachable
Safety Cap

The Sword of the Dragon.

To the Samurai, the sword was more than a weapon. It was power, justice, and the steel bridge to place in the emperor's heaven.

Now reach back over a thousand years. The Dragon Swords. A fusion of tempered 440 stainless steel – and intricately carved faux-ivory. Over 42" of hand-crafted beauty. Perfectly balanced. Touch the wave-frosted blade. The brass guard. Complete with the black lacquered scabbard, and a lifetime warranty.

- The Sword of the Dragon #SD500 \$159.95
- Matching 30" Dragon Sword #SD600 \$119.95



FedEx
extra



THE NEXT GENERATION T.V. REMOTE

Command your TV with the next generation in universal remotes.

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PHOTOS BY JIM WILSON

Flubbed Maneuver Limits View Of Su-37 Aerobatics

FARNBOROUGH, ENGLAND—While watching test pilots fly at the Farnborough Air Show, you might get the impression that the law of gravity is only a polite suggestion. There are no trophies for fancy flying, but dazzling performances can seal multibillion-dollar aircraft deals.

plane's engine-thrust-diverting capability to lift its nose and then twirl it around 360°, virtually pivoting on its tail. By the time it has completed this tight-diameter loop, its airspeed has dropped to below 50 knots. This gives the pilot an opportunity to fire at an enemy streaking past and



because they said he couldn't control his plane well enough to keep it from flying over spectator areas.

Meanwhile, turning heads on the ground was the 500-mph *Leopard*. A miniature executive jet under development by CMC Ltd., of Herts, England, the 4-place twin-engine plane looks like a sports car that has sprouted stubby wings. But its most eye-catching feature is its price. At the exchange rates that were in effect at show time, it cost about \$1.3 million, making truly first-class air travel



earns the Su-37MR the nickname "Flanker."

Russian test pilot Yevgeny Frolov performed the kulbit maneuver several times. Unfortunately for Frolov, only a few journalists and janitors who were working after the show got to watch. The show's rules committee wouldn't let Frolov fly his fanciest moves during the public exhibition

Catching on fast to the ways of capitalism, Russia's legendary Sukhoi Design Bureau announced that its hottest new fighter, the Su-37MR, would demonstrate a seemingly impossible aerial maneuver called a kulbit, which is Russian for circle.

In this maneuver, the pilot uses the



something that even relatively low-figure millionaires can afford.

Clockwise from top: Farnborough attractions included the Eurofighter 2000 (shown landing), stealthy B-2A bomber, Kamov Ka-50 assault helicopter, MIG-AT trainer and sporty *Leopard* executive jet.



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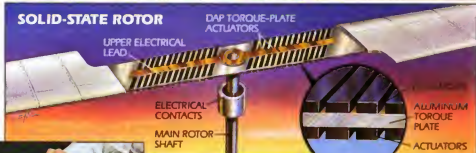
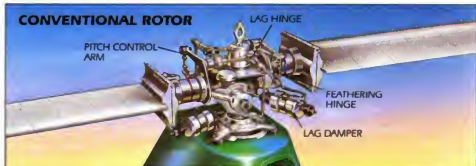
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Helicopter Rotor Goes Electric

AUBURN, AL—It may be time to retire the old joke that defines a helicopter as a random collection of spare parts loosely organized around an oil leak.

Engineers at Auburn University have found a way to eliminate as many as 1000 parts from a helicopter by replacing its complex mechanical rotor hub assembly with a 1-piece Solid-State Adaptive Rotor (SSAR).

In the SSAR system, the blades that create lift and thrust are connected to an aluminum "torque plate" that has piezoelectric actuators on both sides. Varying the direction and amount of current flowing through these elements causes the torque plate and



Eliminating the drag-producing hub will raise chopper top speeds by as much as 15%.

blades to twist, just as if they were controlled by a mechanical assembly.

SSAR will initially be used in surveillance craft, and after its reliability is proven, in manned designs.



Video Store Takes Flight

ALPHARETTA, GA—Watching airline movies can be a no-win proposition. Either the film is one you've seen or one you planned to avoid. Even if you want to see it, you're probably seated too far from the screen.



Passengers can also amuse themselves with videogames.

Coming soon to an airplane near you is an improvement sure to impress even seen-'em-all couch potatoes. The Network Connection's AirView system will make it possible for as many as 200 travelers to simultaneously watch different movies. The system, which costs \$4 million per plane, uses networked computers to put a color screen on every seatback and a multifunction controller or keyboard in the hands of every passenger. The fiberoptic cable that delivers the film will also provide an Internet connection. Expect to see it first on the major airlines' longest international flights.

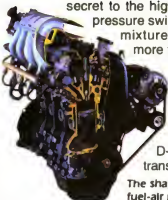
Leaner-Burning Engine

TOKYO, JAPAN—Toyota's new D-4 2.0-liter engine puts into practice the long-standing belief that making small changes in the way fuel is mixed can make big differences in the resulting power and pollution production.

With a 50:1 air-to-gasoline ratio, the D-4 is the world's leanest-burning automobile engine. The secret to the high-performance burn is a high-pressure swirl injector. Swirling stratifies the mixture in a way that concentrates more fuel near the spark plug. When combined with other improvements, the result is better acceleration from a 10% increase in torque and 30% lower fuel consumption.

Toyota says it will mount the D-4 on its vehicles with automatic transmissions beginning this month.

The shape of the piston helps stratify the fuel-air mixture, causing a leaner burn.

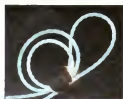


Neon Glows Where Glass Can't Go



ORLANDO, FL—Colorful neon lights will be going more places as fiberoptic cable begins replacing fragile glass tubing.

The cables hold bundled plastic strands. Illumination originates from an enclosure that holds color filters, a lamp and reflector assembly, and a power supply. When energized, the cables glow like glass neon tubes.



Fiberoptic neon glows where vibrations can shatter glass tubing.

In another approach called end-glow illumination, light emanating from the tip of a cable creates a starlike sparkle. SuperVision International used this technique and 30 miles of cable terminating in 66,500 points of light to create the 42-ft.-tall Coca-Cola bottle above New York City's Times Square. Off-Broadway, the technology is being used for amusement park rides, airport runways, subway tunnels and mine shafts.

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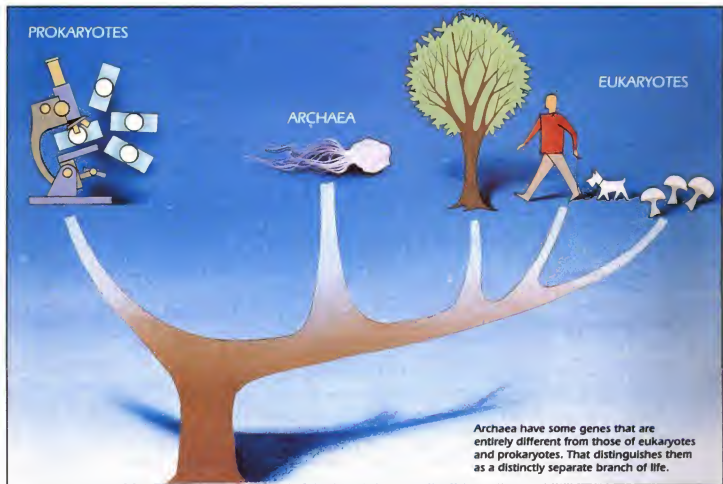


The speakers in conventional radios cannot produce lifelike bass, which is essential for great sound.

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Alien Life, On Earth

BY JIM WILSON, Science/Technology Editor



● Could you recognize an alien if you saw one? Until this past summer, only science fiction writers were paid to think about this question. Today, it is being discussed in the conference rooms of the world's leading scientific institutions.

Starting the serious speculation was NASA's carefully worded announcement that a meteorite that landed in the Antarctic 13,000 years ago contains chemicals and structures that *might* have been created by Martian microbes 3.6 billion years earlier. The announcement also led to the world's first scientific conference on astrobiology.

However, two other discoveries have even more significantly boosted speculation that the universe may be teeming with life, although not necessarily in familiar shapes or forms. The first of these discoveries involves a 1-cell bit of fluff named *Methanococcus jannaschii* (see photo on page 28), and the second involves the oldest fossil found on Earth.

"Our understanding of *M. jannaschii* significantly increases the likelihood that life exists on other planets," says J. Craig Venter, president of The Institute for Genomic Research (TIGR), in Rockville, Maryland. The research organization worked with scientists from the University of Illinois, in Urbana, and The Johns Hopkins University, in Baltimore, to map the genes of the unusual organism.

It's clear that *M. jannaschii* is different from almost everything else that lives on Earth. It thrives at coffee-percolating temperatures, gulps iron and sulfur and belches natural gas. And if you think it behaves strangely, check out its neighborhood. Researchers from the Woods Hole Oceanographic Institution found the specimen thriving at steel-bending pressures about 2 miles beneath the Pacific Ocean, 100 miles south of Cabo San Lucas, Mexico.

Organisms that thrive under ex-

treme conditions are novel but not unique, Ken Nealson of the Center for Great Lakes Studies reminded the scientists participating in the first Astrobiology Workshop. The meeting was held at NASA's Ames Research Center at Moffit Field, California, several weeks after the Martian meteorite find was announced. "Bacteria are found in environments ranging from 23° to 248° F, from pH values of zero [battery acid] to 10 [detergent] and salinities ranging from distilled water to hypersaline brines," he says.

True enough, but the DNA analysis of *M. jannaschii* shows that it is no more a form of bacteria than it is a Labrador retriever. "In decoding the genomic structure of *M. jannaschii*, we were astounded to find that two-thirds of the genes do not look like anything we've ever seen in biology before," says Venter.

His findings confirm that it is part of a distinct form of life called "ar-
(Please turn to page 28)

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chaea." The name derives from the Greek word for ancient, reflecting the belief that *M. jannaschii* was capable of surviving the harsh, poison-filled environment scientists imagine existed on Earth nearly 4 billion years ago. They also established beyond question that the archaea are a distinct branch of the so-called tree of life. The traditional school of thought held

that the tree had only two branches. Life forms big enough to be seen, along with much of the microscopic world, are collectively referred to as "eukaryotes." The name implies that their cells contain a nucleus. Bacteria and blue-green algae, which lack a nucleus, are termed "prokaryotes."

For the roughly 20 years that biologists have known about the archaea, they have suspected they were a form of bacteria. Leading the opposition to this idea was Carl R. Woese, an evolutionist at the University of Illinois who proposed that they are actually a separate branch of life. After mapping the location of each of the 1738 genes in *M. jannaschii*, the

TIGR team concluded it is neither a prokaryote nor a eukaryote.

"There are genes here that are totally bacterial-like and others that distinctly resemble eukaryotes," says Venter. In terms of the way it passes genetic information to future generations, *M. jannaschii* is similar to eukaryotes. Yet, the way it converts material from its surroundings into

something out of science fiction. Not so long ago, no one would have believed you if you'd told them such an organism existed on Earth," says Venter, who says it is not inconceivable that archaea might have originated elsewhere in the solar system.

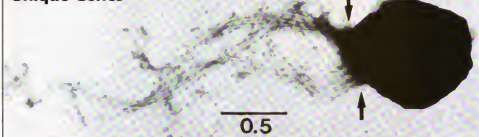
"This organism is as good a candidate as you could want for something arriving on a Martian meteorite,"

says John N. Reeve, a microbiologist at Ohio State University, in Columbus. This sort of support from life scientists has revived interest in a controversial proposal about the origin of life raised in the 1970s by

astronomers Fred Hoyle and Chandra Wickramasinghe of the University of Wales. They suggested that life didn't originate on Earth, and that it took root here after arriving from space. "I believe there is life on every bit of the solar system that has a habitable region," says Wickramasinghe.

The two astronomers managed to alienate most of the scientific community by publishing a book titled *Diseases From Space*. In it, they argued

Unique Genes



The normal Earth environment is poisonous to *M. jannaschii*. Area is one-half of a micron.

new cell mass is similar to how bacteria behave. The immediate effect of the genetic mapping of *M. jannaschii* has been to vindicate Woese's third-branch-of-life theory. Authors are already revising their textbooks.

Because so many of the genes found in *M. jannaschii* are so different from those in known forms of life, scientists can't help but ask if this exotic organism might not have an extraterrestrial origin. "It's like

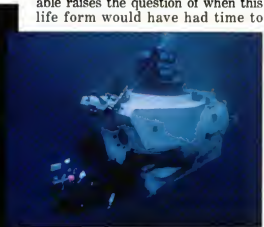


that the small size of bacteria and still smaller size of viruses make it possible for them to fall to Earth without the friction of the atmosphere heating them to the temperatures that vaporize larger material. To support their argument, they presented evidence suggesting a direct linkage between meteor showers and historic plagues.

Another discovery may justify renewed consideration of Hoyle and Wickramasinghe's theory. A team led by Stephen Mojzsis, a doctoral student at the Scripps Institution of Oceanography, in La Jolla, California, announced that its analysis of a rock found in Greenland suggests that life existed on Earth 3.87 billion years ago. Previously, the oldest fossil was

or so years, continuous heavy bombardment by swarms of giant comets, city-sized asteroids and massive meteorites would have caused environmental disruptions that would have made it difficult, if not impossible, for life to establish itself.

The discovery of a fossil whose age coincides with the time at which the Earth first supposedly became habitable raises the question of when this life form would have had time to



Submersible *Alvin* recovered *M. jannaschii* from near a "white smoker" thermal vent.

It will, at a minimum, take the discovery of living Martian organisms with genes similar to *M. jannaschii* or some other terrestrial creature to convince skeptics that Hoyle and Wickramasinghe are right.

believed to be 3.46 billion years old.

Pushing back the date that marks the planet's first inhabitants to nearly 3.9 billion years ago is significant. The Earth is believed to be about 4.5 billion years old. For the first half-billion

evolve. If Earth was too inhospitable for life to exist here before 3.9 billion B.C., perhaps, as Hoyle and Wickramasinghe have suggested, life really did begin "out there" and it simply fell to Earth.



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Free Energy

BY BRIAN C. FENTON, Electronics Editor

● Sometimes you can get something for nothing. Don't get me wrong—the laws of physics are rules that I live by. The first law of thermodynamics is my particular favorite. It describes the principle of conservation of energy: Energy can neither be created nor destroyed, just transformed from one form to another.

This principle is the one that does away with the notion of perpetual-motion machines. If you believe they exist, then I'm sorry to inform you that they don't, and they never will—although there will probably be people trying to build them, and gullible people to buy them, in perpetuity.

I recently came across two products that don't violate any laws of physics, but they come as close as you can to perpetual motion. They create useful energy virtually for free.

The first is the Freeplay windup radio from Bay Gen, a South African company. The radio is being marketed in the United States by Windup Technologies for about \$150.

The radio has a mainspring—a 30-ft.-long coil of steel. Crank the handle for half a minute to wind the mainspring, and the radio will play for about a half-hour.

The radio was originally marketed for people in developing countries, where radio is a far more accessible medium than TV for news and entertainment. Unfortunately, the availability of electric power can't be taken for granted in most of the Third World, and the cost of batteries could easily use up a substantial portion of an average household's annual income. So this radio is a sensible alternative.

The windup radio receives the standard AM and FM broadcast bands and also shortwave—either 3.3 to 12 MHz or 6 to 18 MHz, depending on the model.

What's the first thing you do when a blackout hits? I don't run for the flashlight, I run for the radio. I've been through

week-long power outages courtesy of hurricanes—and I never want to be caught without a radio and not enough batteries again.

I feel a lot better knowing that my windup radio—which has become my emergency radio—will be ready when I need it. No matter how long it sits unused, it won't be destroyed by leaking batteries or simply be the victim of dead batteries.

When the next power failure hits, I'll know what time it is, too. That's because I'll have a Seiko Kinetic watch on my wrist.

Do you remember when watches didn't need batteries?

If so, you probably remember not only having to wind your watch daily but also having to reset the time often to keep it accurate. Maybe you were lucky and had a self-winding watch. But you probably still had to reset the time frequently because the watch's timekeeping was based on the unwinding of a mechanical spring and was thus prone to inaccuracies.

Even the cheapest watches today are extremely accurate—at least until the batteries fail—thanks to the quartz crystals on which they're based. Seiko came up with the idea of creating an automatic "self-winding"

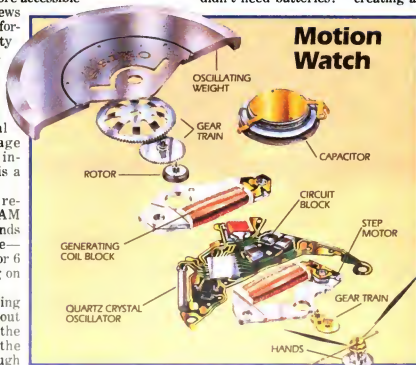
watch in which an oscillating weight is used as the rotor of an electrical generator. The voltage from the generator is stored in a capacitor and released to power the quartz oscillator circuitry.

The Kinetic's circuitry is so efficient—it consumes about one-millionth of a watt—that once fully charged, the watch can run for up to 2 weeks even if it isn't moved the whole time. According to Seiko, just brushing your teeth and washing your hands can provide about 5 hours of energy, and driving for an hour can keep the watch running for 15 hours.

If that's not free energy, then what is? **FM**



FM ILLUSTRATION BY PAUL CHAVES



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All-Tech Vehicles

BY RICH TAYLOR, Outdoors Editor

● Perched on a mountaintop in Montana—the sun just an afterglow in the western sky, ominous clouds rolling up to envelop the trail from below—I feel glad when my new Yamaha Big Bear 4x4 ATV hums to life at the first tickle of the START button.

My buddies and I race down the slopes to escape the clouds, bouncing over foot-ball-size boulders, running along the edge of a 2000-ft. drop-off and dodging through fragrant pine forests until we reach a smooth, gravel fire-road that leads back to our rustic headquarters in tiny Wallace, Idaho.

Yamaha Big Bear 4X4 ATV

This is just one memorable evening of a spectacular 2-week odyssey that takes me from Deadwood, South Dakota, to Spokane, Washington, to ride new 4-wheel-drive sport/utility ATVs. Yamaha's Big Bear feels sportier than the Kawasaki Prairie. This is because for 1997 it uses many components from the high-performance Wolverine model.

The heart of this mighty workhorse is an air-cooled 348cc 4-stroke sohc single equipped with a CDI ignition system, an automatic clutch and a constant-mesh 5-speed transmission. High and Low ranges provide a terrific choice of high-speed excitement or low-speed grunt. Unlike many ATVs, Reverse is easy to find and use with just the turn of a knob and a kick at the shifter.

The Big Bear 4x4 uses shaft drive to both front and rear axles. New this year are a frame and suspension, derived from those on the Wolverine, that give the Big Bear 6 in. of travel in both the double-wishbone front suspension and swing-arm rear. A drum brake hides behind each front wheel, and in the rear is a single drum. The Big Bear 4x4 is a true sport/utility. In addition to a full-size rider, it can carry a total of 264 pounds on its front and rear racks. Yet it accelerates, stops, corners and climbs like a sport machine. Yamaha will sell the Big Bear 4x4 for just

KAWASAKI PRAIRIE 400 4X4



\$5299, which is \$400 less than last year's model and one of the best buys in the ATV market.

Kawasaki Prairie 400 4X4 ATV

Similar in size and performance to the Yamaha Big Bear, the big Prairie 400 4x4 is even easier to ride, thanks to a new continuously variable transmission that Kawasaki calls KAPS. This uses a Kevlar belt and torque converter to give smooth power delivery in either High or Low range. A tank-mounted lever selects Forward/Neutral/Reverse. After that, it's just press the throttle, hang on and ride.

Not having to shift makes the Prairie by far the easiest ATV to ride that I've ever been on. This is a heavy, powerful top-of-the-line machine with a price tag of \$6199. But if I were buying an ATV for a novice rider, this is the one I would choose. It's the ATV equivalent of a Cadillac: smooth, plush and darn near fully automatic in operation.

KAPS isn't the only interesting part of the new Prairie 400. The engine is a liquid-cooled 391cc sohc single that incorporates a crankshaft balancer and rubber engine mounts to reduce vibration. This happy powerplant breathes through an elaborate high-mounted snorkel air intake. A second snorkel cools the KAPS belt

and torque converter. I repeatedly rode the Prairie 400 through streams that were over my knees, and neither the Kevlar belt drive nor the engine ever missed a beat.

Because the continuously variable transmission operates the same way in Forward or Reverse, theoretically one can back up at 50 mph. To prevent this during normal maneuvers, Kawasaki has a rev limiter that restricts the engine to 3500 rpm in Reverse. An override switch allows full rpm for heavy loads.

The single rear swing-arm is a monoshock unit, while the independent front suspension uses automotive-type MacPherson struts. Wheel travel is an impressive 6½ in. in the front and 7 in. in the rear.

Front brakes are automotive-style hydraulic discs, and the single rear brake is a hefty drum. Shaft drive is used both front and rear. The front differential is limited-slip for precise steering and a tight turning circle.

All in all, the new Kawasaki Prairie 400 4x4 and Yamaha Big Bear 4x4 are at the top of the class of 1997 sport/utility ATVs. Either is easy for a novice to ride, yet tough and fast enough for experienced riders to enjoy. After riding hundreds of miles on these two machines, I believe the ante in the sport/utility category has been raised another notch or two. **TM**

PM HOTLINES

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SCIENCE SOLVES THE

ANCIENT MYSTERIES OF THE BIBLE

BY MIKE FILLON
PM Illustrations by
Bryant Eastman

Technology and a better understanding of natural processes may explain how these seemingly impossible events occurred.

• Noah's ark, Lot's wife, Moses parting the Red Sea, Lazarus rising from the dead. Whether you are a regular churchgoer or attend only weddings and funerals, these stories are intimately familiar. For centuries, theologians have looked beyond the stories' implausible aspects, focusing instead on their moral messages of divine punishment for the wicked and reward for the good. Now—with the help of high-tech methods including radar imaging, computer simulation and chemical analysis—scientists are becoming convinced that there may be another dimension to these miraculous tales.

What the Bible's authors interpreted as miracles may have been phenomena of nature.

This theory has been garnering closer scrutiny over the past several decades. Steve Prothero, assistant professor of American Religious History at Boston University, says this is a result of the increased use by biblical scholars of archeological research. "Prior to that, what people were really working with were texts," Prothero says. "Now, with some interesting finds, such as early church meeting places, they've really gotten into doing archeological research to fill out their view of the early church and their understanding of the New Testament."

In this spirit, **POPULAR MECHANICS** reports these latest scientific explanations of some of the most awe-inspiring miracles of the Bible.

Noah And The Ark

Not too long ago, explorers claimed that they had found Noah's ark atop Mount Ararat in Turkey. Yet, two years ago, what some believe to be Noah's ark was found not on Mount Ararat but on a remote site about 20 miles away, near the border of Turkey and Iran. According to the American and Middle Eastern researchers who have been to the location, the remote site contains a

buried, shiplike object, resting at an altitude of 7546 ft. Some 558 ft. long and 148 ft. wide, the object conforms almost exactly to the 300 x 50-cubit boat that, according to the Bible, God told Noah to build.



Two researchers say Lot could have mistook a human-size salt-block formation for his wife.

Lot's Wife

"When morning dawned, the angels urged Lot, ... 'Flee for your life: do not look back ...' Then the Lord rained on Sodom and Gomorrah brimstone and fire ... But Lot's wife behind him looked back, and she became a pillar of salt."

Genesis; Chapter XIX; Verses 15, 17, 24 and 26

On the surrounding terrain, biblical archeologist Ron Wyatt has identified

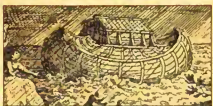
huge stones with holes carved at one end. Researchers believe that these are "drogue-stones," which in ancient times were dragged behind ships to stabilize them. Images returned by ground-penetrating radar indicate unusual levels of iron-oxide distribution, suggesting metal fittings. Salih Bayraktutan, head of geology at Turkey's Ataturk University, estimates the age of the "vessel" at more than 100,000 years. "It is a man-made structure and, for sure, it is Noah's ark," Bayraktutan said at the time of discovery.

David Fasold, an American shipwreck specialist with no religious affiliation, has led the investigation. He says subsurface radar surveys of the site have yielded good results. The radar imagery at about 82 ft. down from the stern is so clear that Fasold could count the floorboards between the walls. Fasold believes the team has found the fossilized remains of the upper deck and that the original reed substructure has disappeared.

As might be expected, their findings have infuriated Christian ark-hunters who are convinced the ark is on Mount Ararat. Fasold has fanned the flames further by claiming the great flood is unrelated to the final resting place of the ark. "[It could have been] an astronomical event causing a tectonic upheaval or a tidal bore causing gravitational pull in the ocean waters that forced the boat into



Using images from ground-penetrating radar, David Fasold and Ron Wyatt have identified and marked shiplike structures inside an ark-shaped formation beneath a site 20 miles from Mount Ararat.



Noah And The Ark

"And God said to Noah, ... 'Make yourself an ark of gopher wood; ... For behold, I will bring a flood of waters upon the earth, to destroy all flesh ...'"

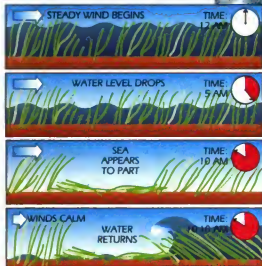
Genesis; Chapter VI; Verses 13, 14 and 17

Moses Parts The Red Sea

"The Lord said to Moses, ... 'Lift up your rod, and stretch out your hand over the sea and divide it, that the people of Israel may go on dry ground through the sea.' ... and the waters were divided."

Exodus; Chapter XIV; Verses 15, 16 and 21

If the event took place on the smaller body of water, 10 hours of moderate wind could have lowered water levels enough to let the Israelites pass.



the mountains," he says. Some of the geophysicists and geologists on Falsold's team are waiting until excavation and carbon-dating are complete before they venture an opinion.

Lot's Wife

For more than a century, archeologists have tried to locate Sodom and Gomorrah. Late last year, two British geologists presented scientific evidence suggesting their actual locations.

Writing in the *Quarterly Journal of Engineering Geology*, geologists Graham Harris and Anthony Beardow said that they believe the legendary Vale of Siddim, where the cities were written to have been, was northeast of the Lisan Peninsula, which juts out and divides the Dead Sea into two basins. Based on their analysis of soil and rock, they theorize that the area was destroyed by an earthquake that toppled buildings and liquefied the rocks and soil underneath the cities. As a result, they say, Sodom and Gomorrah were lost beneath the waters of the North Basin.

There are historical accounts of

similar occurrences. In 37 B.C., the town of Helice in ancient Greece was reportedly lost through liquefaction, as were thousands of miles of area in China in 1921. More recently, a section of Valdez, Alaska, liquefied in the 1950s. Harris says the flood plains near the Lisan Peninsula are notorious for their potential to liquefy under the shock of an earthquake.

Harris and Beardow believe that Sodom and Gomorrah were located near the southeast corner of the North Basin because it was rich in both salt from the Dead Sea and bitumen, or asphalt, which was mined nearby. According to their theory, the bitumen could have ignited during an earthquake and the resulting fire would have helped to destroy the cities. The earthquake and liquefaction of the vast area under the cities were also likely to have created

a tidal wave in the Dead Sea, Harris and Beardow say.

And what about Lot's disobedient wife? The geologists believe she may have drowned as she fled when the tidal wave swept across the Dead Sea. They also speculate that what Lot saw when he looked back from the safety of the mountain was not his wife transformed into a pillar of salt, but a woman-sized block of salt on the newly formed beach. Geologists believe that in those times the Dead Sea was full of salt floes that might have been thrown up by the surging waters.

To date, no artifacts have been recovered to support the geologists' salt-block theory. They hope to recruit a team to further explore the area.

Moses Parts The Red Sea

For nearly a century, there has been speculation that the Red Sea mentioned in Exodus is not the huge 100-mile-wide expanse as it is known today, but the western "finger" of the Red Sea—which is now called the Gulf of Suez—that extends to the border areas of Egypt. This notion stems from the fact that the original Hebrew phrase for Red Sea was "yam suph," which actually means "Reed Sea."

This phrase most aptly describes the lake region north of the Gulf of Suez, including the Bitter Lakes and Lake Timsah. According to the account in Exodus of Moses's feat, enough water was present initially to block the fleeing Israelites, and then later to drown the pursuing Egyptians.

Assuming all of that is true, researchers believe that a logical location for the biblical Red Sea is modern-day Lake Sirbonis. According to a *Bulletin Of The American Meteorological Society* account, computer calculations indicate that because of the peculiar geography of the north-



BIBLE MYSTERIES

ern end of the Red Sea, a moderate wind blowing constantly for about 10 hours could have caused the sea to recede about a mile and the water level to drop 10 ft., leaving dry land for a period of time before crashing back when the winds died down.

Lazarus Rises

Dr. Gerald A. Larue, professor emeritus of biblical history and archeology at the University of Southern California and president of the Committee for the Scientific Examination of Religion (CSER), a secular humanist organization, says it's possible Lazarus was either in a coma or a catatonic state.

Obviously, in biblical times the practice of medicine was not nearly as sophisticated as it is today. Even as recent as the Victorian era, to ensure that no one suffering from catatonia would be buried alive, people were buried in special types of coffins that had tubes running to the surface with bells on top.

Larue says that a person in a catatonic state shows few signs of a heartbeat or breathing. The biblical account leads him to suspect Lazarus was actually in a coma, since in this condition hearing is often the last sense lost. "Assuming Jesus had a loud voice, and he called out 'Lazarus,' the man may have heard him and come out of the coma," Larue says.

A Plague Of Locusts

Locusts in Africa and Asia have been a problem throughout history. Even today after unseasonable rains, hundreds of millions of locusts can appear practically overnight, eating anything green in their path. This is consistent with the order of the plagues in the Bible. The locusts followed unseasonable rains that fell in the form of hail in the seventh plague.



A Plague Of Locusts

"Then the Lord said to Moses, 'Stretch out your hand over the land of Egypt for the locusts, that they may come upon the land of Egypt, and eat every plant in the land...'"

Exodus; Chapter X; Verse 12

There remains, however, this mystery. Most of the plagues were produced at Moses's command, in one case at a time set by the Pharaoh himself, and ceased at his prayer.

The Star Of Bethlehem

The quest for a real star of Bethlehem is complicated by the fact that no one knows exactly when Jesus was born. And because the authors of Matthew and Luke did not write with historical accuracy in mind, their accounts of the event differ slightly. They do agree that Jesus was born during the reign of King Herod, between 37 and 4 B.C.

Ivor Bulmer-Thomas, of the Royal Astronomical Society, says there

was two astronomical events just prior to the end of King Herod's reign. The first occurred in May of 7 B.C., when Jupiter and Saturn appeared very close together in the sky—what astronomers today call a conjunction. It was followed by a near-conjunction of Mars, Jupiter and Saturn in September of 6 B.C.

An alternate theory arises from records kept by Chinese astronomers, says Nick Strobel of the University of Washington Astronomy Department. Strobel says their records report a new star—most likely a nova—in the constellation Capricorn in March and April of 5 B.C., which was visible for more than 70 days. A nova reaches peak brightness within a few days—fading away to invisibility usually takes a few months. The "new star" observed by the Chinese would have appeared in the east several hours before sunrise.

Lazarus Rises

"Jesus said, 'Take away the stone.' ... When he had said this, he cried with a loud voice, 'Lazarus, come out.' The dead man came out..."

John; Chapter XI; Verses 39, 43 and 44

Police officer Gary Dockery (right) spent a remarkable 7½ years in a coma. Full recoveries after 3- and 4-day comas are common. Top, unseasonable rains can lead to swarms of locust insects.



Shroud Of Turin

Perhaps no other Christian relic has undergone as much scrutiny—or scientific investigation—as the purported burial cloth





No relic has been subjected to more scientific study than the Shroud of Turin, shown here being prepared for analysis during a recent round of tests. Carbon dating puts its origin in the 13th century, but these tests may have been flawed.



Shroud Of Turin

"And Joseph took the body, and wrapped it in a clean linen shroud, and laid it in his own new tomb,..."

Matthew; Chapter XXVII; Verses 59 and 60

of Jesus. The shroud is a linen cloth, woven in a three-to-one twill and measuring a bit over 14 ft. long \times 3½ ft. wide. It is wrapped in red silk and kept in a special silver chest in the Chapel of the Holy Shroud in the cathedral of St. John the Baptist in Turin, Italy. What mystifies believers and nonbelievers is that it carries a negative image of a crucifixion victim, a fact not known until 1898 when the first photographs of it were taken.

Those who believe it was Jesus's burial cloth argue that even if an artist in the Middle Ages was clever enough to create such a sophisticated hoax, it is unlikely that he or she would think to create a negative image—knowing somehow that photography (not to be invented for another 400 to 500 years) would reveal the true image in their art.

It is immediately apparent to most who see photos of the shroud that it contains the image of a brutally beaten man. The wounds correspond with the biblical accounts of the Crucifixion, with one important exception. The spike marks are in the wrists, rather than the palms of the hands. This is a particularly telling departure from biblical text. More important,

modern forensic science has determined that spikes through the palms of hands cannot hold the weight of a body on a cross.

Joe Nickell, author of the book *Inquest On The Shroud Of Turin*, says that the verifiable history of the shroud can be traced back no further than between 1260 and 1350.

He points to carbon-14 dat-

ing conducted in 1988 by three independent laboratories.

Since then, researchers at the University of Texas at San Antonio Health Sciences Center have offered an interesting twist on the carbon dating. They say that microbial contamination may have thrown it off. According to microbial physiologist Stephen Mattingly, threads from the shroud are covered in a thin, strong

biopolymer produced by microorganisms living on the fabric. According to Mattingly, because living organisms take in carbon, their presence in the shroud could have

The Burning Bush

"And the angel of the Lord appeared to him in a flame of fire out of the midst of a bush; and he looked, and lo, the bush was burning, yet it was not consumed."

Exodus; Chapter III; Verse 2



The biblical lands sit atop a sea of gas and oil. Some suspect that Moses saw a natural gas seep that was ignited by lightning.

confused the instrumentation into dating the cloth as younger than it is.

Many people undoubtedly believe that attempting to corroborate God's word with physical evidence is blasphemy. Yet, a number of modern religious leaders are comfortable with the biblical archeology approach to examining ancient scriptures. "The words of the Bible are not themselves the Word of God," says Rev. Vernon Robbins, a professor in the Religious Studies Department at the Candler School of Theology, in Atlanta. "They are human language that is presenting the Word of God."

NEW CARS 1997

Part 2



for the carmakers may have saved their best for last.

BY DON CHAIKIN, Automotive Editor

● Everybody just wants to have fun. At least that is how it seems in the automobile industry. As we reported in the first part of the new-car roundup back in October, 1997's crop of new cars is bristling with excitement and daring concepts. Well, we're happy to tell you in the second half of the report that the adrenaline will continue to pump—even from some manufacturers not usually associated with heart-pounding driving excitement and traffic-stopping good looks.

Here's the rundown on the '97s that were introduced too late for our earlier report.

Acura

Sport-luxury coupes need both performance and lots of amenities to be successful. When Acura introduced its CL earlier this year, it had the luxury, but the only engine available then was the 145-hp VTEC Four. Now the other shoe has dropped, to the tune of 200 hp and 195 ft.-lb. of torque. The new VTEC 3.0-liter sohc V6 engine, like the car, is made in Ohio.

The car already had superb handling, excellent quality and the amount of neat, well-executed comforts you'd expect in any Acura. Now, it has the power.



JAGUAR XK8

Audi

Audi is continuing its slow and steady climb back from its near-death experience in the '80s. The company's A8 is a stunning technological tour de force—exciting to drive and a marvel to behold. For more details, see our First Drive report on page 46.

Buick

Besides the big news, like the new Century (see the October issue) and the Regal (you'll have to wait

NEW CARS
1997



FIRST DRIVE

Audi A8

• With a frame and bodywork made entirely from aluminum, the V8-engined A8 easily weighs less than 4000 pounds, or 600 pounds less than its nearest competitors, the BMW 7-series and the Mercedes-Benz S-Class sedans. There's a

choice of a 3.7-liter engine and front drive or a 4.2-liter motor and all-wheel drive—unique for luxury cars of this class. You'd hardly guess about the aluminum construction, because the ride is solid and quiet, even at ludicrously high Eurospeeds. The styling we'll politely call conservative, which is out of character for a car that was so groundbreaking. The A8 does have creature comforts, like leather

seating and enough wood trim to start a campfire. Traction control, ABS and airbags (six in all) all around place the A8 at the top of the list for safety items, and a European test agency reportedly performed a 34-mph offset crash that resulted in so little deformation that the doors opened properly. Performance, handling and braking are all brisk, due in part to the low weight.

—Mike Allen

until next month), Buick's Riviera gets revised. The changes are not radical, but they're just enough to make the car even more rewarding.

Most of these refinements are in the suspension: new aluminum control arms, knuckles and related hardware that reduce the car's unsprung mass.

Honda

As Acura, Honda's luxury division, ups the ante with its 3.0 CL, its parent company also increases the heat with an all-new Prelude (see our First Drive report on the opposite page).

The Prelude boasts new styling and a well-laid-out, roomy interior. The back seat isn't good for big people on

long rides, but there's a surprising amount of headroom, and there's enough space for an average-size adult.

Hyundai

The Korean carmaker once known for its inexpensive if somewhat dull cars of somewhat questionable quality seems to have learned some important lessons. The company's impressive new coupe for 1997 is the Tiburon. See our First Drive report on the opposite page.

Infiniti

Infiniti and Lexus were launched in 1989, and it seems that all Infiniti has been doing since is chasing Lexus.

Infiniti's Q45 sedan was different from Lexus's LS 400: It was starker, leaner, meaner and far less successful.

Enter

the '97 Q45. This car is more similar to its rival than it is to its predecessor.

The new Q has a shorter wheelbase and weighs about 200 pounds less. It also has a new 32-valve dohc V8 that's smaller and less powerful than the previous powerplant. The new engine develops 266 hp from 4.1 liters, versus 278 hp from the former 4.5 liters. The abundance of wood, the softer leather and the large-car feel should charm a broader crowd than the first Q.

Jaguar

Ever since Sir William Lyons drew the shape of the first XK sports car 50 years ago, Jaguar has been synonymous with alluring, eye-catching sports cars. Unfortunately, for too many years, that association was based more on fond memory of cars gone by than what was actually available at Jaguar dealers. Now, once again, there's a real Jag—available as a coupe or a convertible—to turn heads and gather crowds. This one is the XK8. It's Jaguar's first V8-powered car and, despite the fact that Jaguar is owned by Ford, the engine is *not* a Ford. For details, see our First Drive report and Closer Look on page 48.

Kia

It may still be a relatively small player with dealers in just 22 states, but it's a tough one. As Kia adds new dealers to the fold—the Northeast and mid-Atlantic regions



ACURA
3.0 CL

FIRST DRIVE

Honda Prelude

● This is the fastest and best-handling Prelude since Honda introduced the car in 1979. In fact, this is the best handling front-wheel-drive car we've ever thrown into a corner.

Two models will be available, the Prelude and the Prelude Type SH (Super Handling), each powered by a revised version of Honda's 2.2-liter 16-valve twin-cam VTEC Four. The VTEC system remains unchanged.

However, a new open-deck block and changes to the exhaust system and valve timing have given the motor a slight boost in midrange power and upped the horsepower rating to 195 hp in cars with the manual 5-speed transmission. The engine is rated at 190 horsepower in cars equipped with



the 4-speed automatic, which features Sequential Sportshift—Hondaspeak for a manual mode that works much like Porsche's Tiptronic and Chrysler's Autostick.
—Scott Oldham

early in '97 and the Midwest next year—the company is getting exclusive showrooms for its products.

For this year, Kia is reintroducing the Sportage with a more powerful 2.0-liter 16-valve dohc engine that's good for 130 hp and 127 ft.-lb. Other features include a new grille, cup holders and a knee airbag (see Closer Look at right). Available in both 2wd and 4wd versions, with manual and

Mercedes-Benz

You've seen spy photos for months. You've seen arch-rival BMW launch its Z3 open-top 2-seater. Well, now you can stroll down to your local Mer-

Mitsubishi

For '97 there's an all-new version of Mitsubishi's flagship sedan, the Diamante, as well as a new Galant.

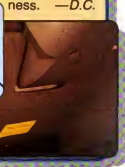
The Diamante driving experience is

CLOSER LOOK

KIA Knee Airbag

- All vehicles utilize some sort of restraint below the dash to keep front-seat occupants from sliding out from under their seatbelts in a frontal collision. Kia is the first maker to use an airbag beneath the steering column for this purpose. The small bag is trig-

gered by the same sensor as the steering-wheel bag. But because of its smaller size, it inflates faster than a regular airbag to ensure its effectiveness. —D.C.



KIA SPORTAGE

automatic transmissions and a smorgasbord of standard equipment, the Sportage should do well while riding the crest of popularity and advertising surrounding Toyota's RAV4 and the soon-to-be-introduced Honda CR-V.

cedes-Benz dealership and kick the tires on the

SLK230. The SLK is powered by a 2.3-liter supercharged dohc Four, which is good for 191 hp and 206 ft.-lb. of torque and is mated to a 5-speed automatic. See our First Drive report on page 49.

very Lexus-like. Although 243 pounds lighter than the car it's replacing, thanks to the use of aluminum in the suspension, subframe and crossmembers, the Diamante can still use more muscle. The new 3.5-liter 24-valve sohc V6 makes 210 hp at 5000 rpm and 231 ft.-lb. of torque at 4000 rpm. The engine is backed by a 4-speed automatic.

The Diamante is

FIRST DRIVE

Hyundai Tiburon

● The Tiburon (which means "shark" in Spanish and is a small coastal town near San Francisco) is a front-wheel-drive sport coupe for people who really want a Toyota Celica but whose wallets demand a Corolla.

Two versions are available: the base Tiburon and the more powerful Tiburon FX. The base car comes with a 130-hp 122-ft.-lb. 1.8-liter 16-valve 4-cylinder. FX buyers get 10 more hp and 10 more foot-pounds of torque from a 2.0-liter dohc Four. Both engines are Hyundai's own and are smoother than the 4-cylinder in



an Eclipse or a Celica. The power delivery is very linear, pulling right past the 6500-rpm redline. The car is not a rocket, but it's no slug. The handling is just as impressive—this car is fun to throw around. More im-

pressive, though, is how solid it feels—from the stiffness of the chassis over rough roads, to the clean thud of the doors, to the precise fit of the high-style interior panels. Hyundai has come a long way.
—S.O.

**NEW CARS
1997**

MITSUBISHI DIAMANTE



MITSUBISHI GALANT

uned for a relaxed ride, not high-trung handling.

Back at Mitsubishi headquarters, he company conducted its own Galant-athon and implemented nearly 100 changes to the Galant. Among them is he availability of a Chrysler-built 41-hp 2.5-liter V6 in a small number of top-dog LS models.

Nissan

Some important changes have been made to the 240SX for 1997. The car has a new look with a new front end—highlighted by a set of

jewel-like multiparabola headlights—as well as new taillights and wheels.

Unfortunately, the car is still powered by a tepid 155-hp 2.4-liter dohc 4-banger. However, the 240SX's new, stiffer suspension tuning offers a ride similar to a '96 Prelude, a ride quality Honda has left behind. Nissan's Maxima shares the 240's new headlights for

'97. The sedan also gets new front and rear bumper fascias as well as a freshly designed decklid and new taillights.

Porsche

If you've been teased by Mercedes with its SLK crescendo, then you've probably been just about tortured by Porsche and its Boxster buildup. Well, it's finally here—see our First Drive report on the opposite page.

Volvo

The carmaker whose name has become synonymous with safety is trying hard to make sure that it's not synonymous with boring, too. Therefore, it's bringing out a new car called the C70. And guess what? It's

FIRST DRIVE

Jaguar XK8

● Since 1948 and the XK120, Jaguars have been all about sex appeal. The XK8 continues that grand tradition as a thoroughly modern grand-tourer.

The traditional long and svelte hood houses a V8 that is backed by an electronically controlled 5-speed automatic. The passenger compartment seats two easily and luxuriously. (There are two "seats" behind the front seats, but these should be used only for storage or punishment.) There's the traditional Connolly leather upholstery and burl walnut, but all the switches are actually ergonomically designed and placed. Driving along the mid-Atlantic coast through a hellacious rainstorm, all of the car's electrical components worked unflinching, and not one drop of the moisture made it inside the car.

Like its predecessors, this car is for fast, comfortable and competent cruising. It's not going to smoke its tires from spotlight to spotlight.

But, then again, like its predecessors, it doesn't have to do that in order to be noticed.

—D.C.



CLOSER LOOK

Jaguar's First V8

● The aluminum 32-valve dohc V8 powering the XK8 is the first-ever V8 from Jaguar. Aside from power (with 290 hp and the same number of foot-pounds, it has a bodacious amount), the engine's designers were most concerned with smoothness. The 4.0-liter V8 has a lip across the valley to join the upper ends of the block for vibration resistance. Add in a main-bearing bed plate, as well as a structural lower crankcase, and the overall result is one very rigid engine. —Paul Weissler



FIRST DRIVE

Porsche Boxster

● Porsche has always made sports cars. But in the past few years, it has lost sight of its market by pricing its cars too high for a sports car's best market—people young enough to enjoy driving fast and well. Porsche started to reverse this trend by reducing the price of the current flavor of 911 by many thousands of dollars. The German carmaker has followed that up by introducing the Boxster at the promised just-a-squeak-under-forty-grand price.

The Boxster will attract some buyers who have been buying sporty Japanese and American cars—and they'll like it. Start with the 2.5-liter water-cooled flat-Six engine, which



produces 204 horsepower and is mounted where the good Dr. Porsche intended, in the car's center. This leaves room for two capacious trunks, and that's with the metal-and-cloth convertible top either up or down. The radiators are mounted flanking a large front trunk. Seating is

large and luxurious for two, with no pretense of accommodating any more. The cleverly designed top goes up or down in 12 seconds, unassisted. There's a 5-speed manual box, with a good-but-not-great cable shifter, and a 5-speed version of the Tiptronic semiautomatic trans.

—M.A.

actually good-looking in a sexy, rakish kind of way that most people don't associate with Volvo. First there will be a couple version, followed next year by a convertible.

Based on the front-drive 850 platform, the C70 is 2 in. longer than the 850. The base of its windshield is about 2 in. farther



INFINITI Q45

charged 5-cylinder engine that is used in the European-spec 850 Turbo.

Sharing that vehicle's turbocharged 5-cylinder drivetrain, the C70 has the acceleration and handling to back up the car's curves, bulges and alluring lines. The interior is swathed in Volvo's leather-and-wood

brand of luxury, with room for four full-size grown-ups.

PM

forward than the 850.

The C70 is powered by the same turbo-

VOLVO C70



FIRST DRIVE

Mercedes SLK

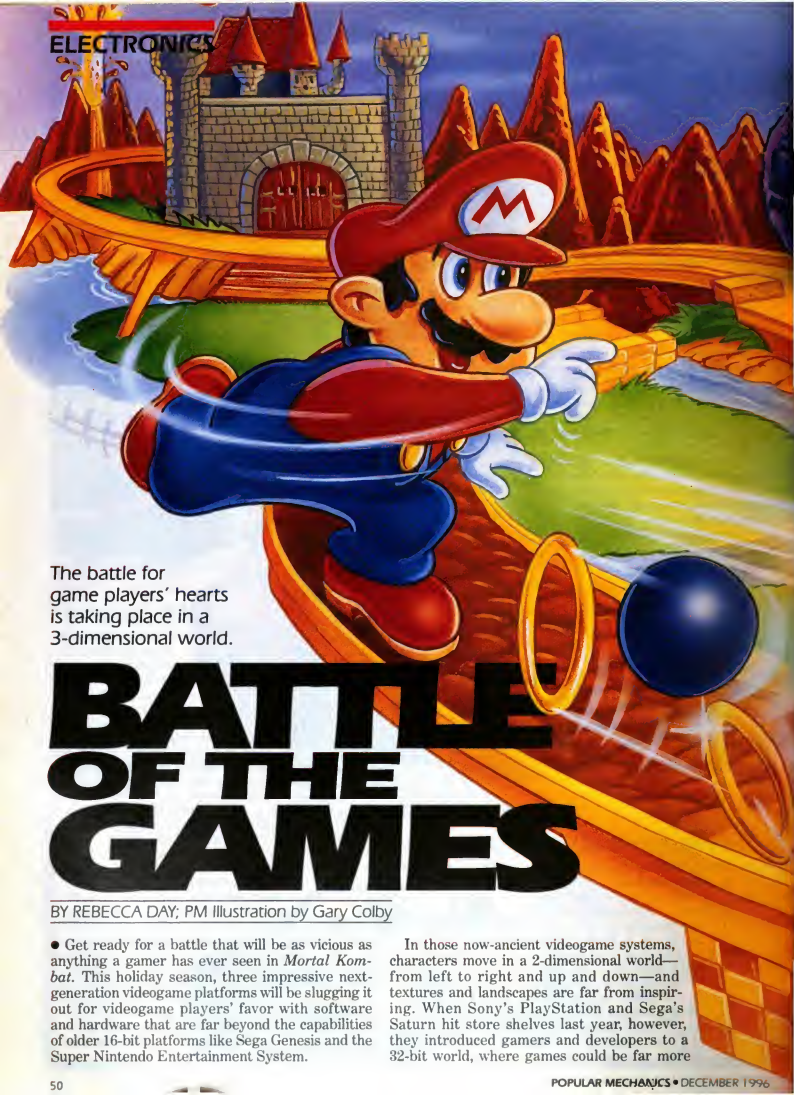
● Leave it to Mercedes-Benz to conceive, engineer and build the perfect car. Granted, no car is perfect and every car is a compromise. But for what it is—an entry-luxury sports car—there is nothing better. And apparently, carbuyers know a good thing when they see it. Despite a \$40,000 price tag, Mercedes reports that it is already sold out of the 2-seater worldwide through 1998 and the car hasn't even

gone on sale yet. So what's so great about it? For one, it looks fabulous. It's definitely a Mercedes, yet as sleek and contemporary as anything on the road. For another, the steel roof folds

back with the touch of a button, instantly transforming the coupe into a glorious open-air convertible. What's more, the SLK has standard features other carmakers are just starting to think about, like side airbags mounted in the doors and a child recognition system that prevents the dash-mounted passenger's-side airbag from firing if a child is sitting in the passenger seat. It all adds up to a car that is a fantastic ride and, yes, a great value.

—Joe Oldham





The battle for game players' hearts is taking place in a 3-dimensional world.

BATTLE OF THE GAMES

BY REBECCA DAY; PM Illustration by Gary Colby

● Get ready for a battle that will be as vicious as anything a gamer has ever seen in *Mortal Kombat*. This holiday season, three impressive next-generation videogame platforms will be slugging it out for videogame players' favor with software and hardware that are far beyond the capabilities of older 16-bit platforms like Sega Genesis and the Super Nintendo Entertainment System.

In those now-ancient videogame systems, characters move in a 2-dimensional world—from left to right and up and down—and textures and landscapes are far from inspiring. When Sony's PlayStation and Sega's Saturn hit store shelves last year, however, they introduced gamers and developers to a 32-bit world, where games could be far more



BATTLE OF THE GAMES

compelling than anything outside the powerful arena of arcade games. Nintendo's 64-bit system, launched in late September, boasts even more prowess with its RISC-based brain.

Why the quantum leap in the game experience? In a word, 3D. For the first time, 32- and 64-bit processors offer game developers enough power to create games in a 3-dimensional environment, and the results for gamers are awesome. You don't just play a videogame anymore, you enter the game. You look around a 360° world from the characters' perspective, see what the characters see, move forward and backward, and make moves that can wow even the most daring extreme-sports buff.

That's not all. With the new game systems, texture-mapping reaches a level that adds realism to game play that was never before available on a home game system. Characters now have shadows, a cloud-filled sky looks almost as realistic as one recorded on VHS tape, and developers can create mood with such effects as fog and smoke for an enhanced experience.

Nintendo—which leapfrogged the 32-bit generation in favor of a 64-bit platform—hoped that about 15 titles would be available in time for Santa's first night. The cartridge-based game system will carry a price tag of \$199, just like the 32-bit CD-based Sega and Sony players. Sony's PlayStation is expected to be supported with a library of 150 titles by the end of the

chines are far from frivolous. Each of the game systems packs enough power to equal a computer workstation. Inside every Sega Saturn console, for example, are eight processors whose duties are divided up into audio, video and control functions. Three Hitachi RISC processors serve as the Saturn's brain: The SH-1 micro-processor controls the dual-speed CD-ROM subsystem, and a pair of SH-2 32-bit processors double the potential processing power to improve game speed and reduce wait time.

In addition, Saturn boasts two video-display processors, which are responsible for the 3D and background effects. The processors can generate up to five backgrounds simultaneously and can rotate two playfields at once. A Motorola 68EC000 sound processor and a Yamaha FH1 digital signal processor make up the Saturn's audio

players, the PlayStation's graphics processor provides a maximum of 16 million colors and resolution of 640 × 480 dots. The sound processor can add built-in digital effects, including reverb and envelop. Like the Sega Saturn, the PlayStation supports the Red Book CD standard and can play audio compact discs.

Despite the rest of the industry's move to compact disc, Nintendo has remained loyal to the cartridge—although Nintendo 64 machines are not compatible with earlier versions of the Nintendo Entertainment System.

The primary advantage of the cartridge is real-time gaming. Access time with a cartridge is instantaneous. When a new character appears in a CD game, on the other hand, the wait time can be anywhere from 10 to 30 seconds while the information is spooled from CD to RAM, and that can seem like

an eternity for serious gamers. Designed by Silicon Graphics, the MIPS 4000 Series 64-bit 93-MHz brain in the Nintendo 64 rivals that of a computer workstation, according to David Dienstbier, project manager at Iguana Entertainment, which is an Acclaim company that creates games for all the next-generation platforms. In fact, Dienstbier says, the \$200 Nintendo 64 is more powerful than a \$5000 PC. To a developer, the power of the Nintendo 64 graphics hardware means that less work must be done in software to make up for hardware limitations.

The reality display processor, for instance, provides anti-aliasing, which reduces the jagged look that is typical of bit-mapped images. The Nintendo 64's MIP mapping improves the ap-

year, and roughly 300 titles are available for Sega's Saturn. They may be designed for game play, but these ma-

engine, and surround-sound technology is provided by QSound, which simulates an enveloping soundfield from only two speakers.

The Sony PlayStation packs a 33-MHz 32-bit RISC processor with a 4KB instruction cache and a 1KB data cache. Like the other next-generation



pearance of a textured surface based on perspective, so that a texture viewed up close doesn't look like a giant pixel. The machine's trilinear MIP map interpolation is a sophisticated form of texture-mapping that doesn't warp or distort textures in 3D. And the machine's real-time Z-buffering ensures that graphic images making up a 3D scene are drawn in proper order. All of these functions, performed by the Silicon Graphics floating-point math coprocessor, have to be done in software on the Saturn and PlayStation, Dienstbier says, which is time-consuming and tedious for developers.

The primary advantage of the CD game systems is their vast storage capacity. While developers have to be very aware of how they allocate space on the Nintendo cartridge, game play typically takes up less than 5% of the 600MB disc space available on a CD. That provides developers with an opportunity to add small amounts of data-intensive full-motion video and CD-quality sound to games. *Spot Goes To Hollywood*, for PlayStation, uses only 2% of the disc information for game action, and the other 98% is devoted to 25 audio tracks and 20 minutes of video.

With the quantum leap to 3D graphics accomplished, where does the future of videogaming lie? Sega sees the future on the Internet, and this fall the company will deliver a \$200 Web browser called NetLink that will enable players to both wander through the Web and play games with other players. The major advantage NetLink will have over other browsers, according to Sega, will be

the ability to provide an enormous game library to players as well as networked games.

NetLink fits into a slot on the back of the Saturn and it will

Dille, director of product marketing for Sony Computer Entertainment America. "There's so much to be done now with the machines we currently have," Dille says. "We're just catching up on those." Dille expects this generation of games to have a life cycle of five to six years, which is consistent with previous generations of videogames.

The 3D world also has the potential to open gaming to a much broader audience. Criticized in the

past for its emphasis on fighting games, the videogame industry could make great gains via role-playing and simulation games that take advantage of the 3D environment. "The reason why fighting games became so popular in the videogame market was that when games were converted from the arcades to video, that was all there was," says Ted Hoff, Sega's senior vice president of marketing and sales. "With the power available to them in the advanced game platforms, developers are taking new liberties and creating new stories—not just transfers. In the future, you'll see different games created for different people."

So which system is the one to buy? Typically, it's the quality and availability of the games themselves that determine the popularity of the game. Is there room in the market for three formats? "A lot of people don't think so," says Sony's Dille. "Consumers don't buy all three, and the developers have to place bets on where they're going to put their resources." **PM**



enable users to send and receive e-mail as well, via a 28.8kbps modem.

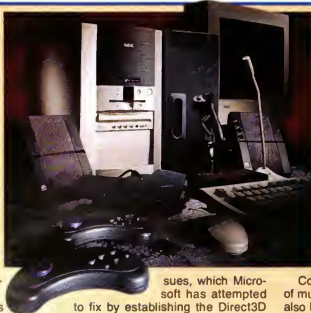
For its part, Sony will steer clear of Net-based gaming, according to Peter

Has The PC Arrived?

● The PC as a game machine will always suffer the reputation of being solitary entertainment. Despite the availability of add-in boards that now offer multiple-player capability, the small screen size of most computer monitors will keep PC gaming to a 1-person sport.

That doesn't mean PC gaming has to lag behind console games in quality advances, however. With the power of the Pentium processor, game developers for the first time have the muscle available to deliver gaming experiences equal to or even better than those available on dedicated consoles.

Computer gaming in the past was slow and far behind the capabilities of even the simplest dedicated console. The genre also was beset by compatibility is-



issues, which Microsoft has attempted to fix by establishing the Direct3D software standard for multimedia 3D titles.

Select models in IBM's new Aptiva line pack an ATI Rage chip set, which delivers

3D graphics that support the Direct3D standard. To underscore its commitment to the PC as a gaming device, IBM is bundling *MechWarrior II 3D Rage Edition* and *VR Soccer* with Rage-equipped computers.

NEC, too, is touting the 3D capability of its new PowerPlayer series of PCs (shown here), which is designed specifically for gamers. The units also have an ATI Rage accelerator on the motherboard and a Diamond Multimedia Monster 3D graphics accelerator, which is built around the 3Dfx Voodoo Graphics chip set used in many arcade games. *MechWarrior II 3D* is one of several 3D titles shipping with the computers.

Compaq, which has its own 8000 Series of multimedia computers for gamers, has also linked up with Sega in a partnership that promises to bring arcade-quality 3D games to Presario PCs next year.

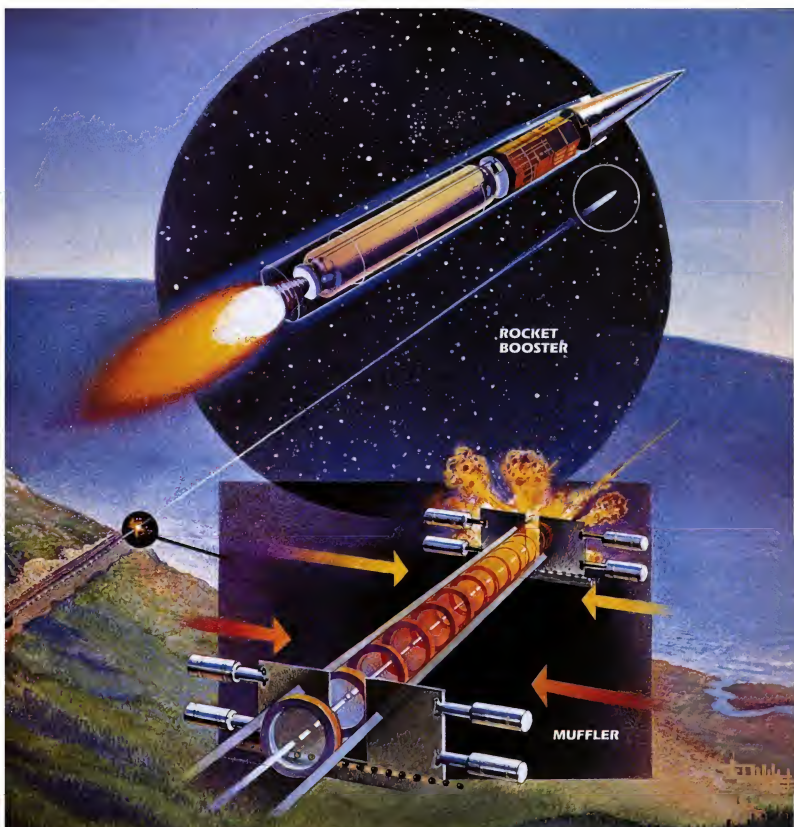
—R.D.

THE JULES VERNE GUN

An ambitious plan to change the way we launch satellites will fulfill the science-fiction writer's dream.



One of the potential U.S. launch sites identified by the Jules Verne Launcher Co. is Alaska. From there, a new generation of low-cost communications satellites could be launched into polar orbit with the help of a small booster rocket. The booster's gas-bid closing doors to allow the payload to pass while trapping noise.



BY SCOTT R. GOURLEY, PM Illustrations by Harold Smelcer

• In his 1865 novel *From The Earth To The Moon*, author Jules Verne describes a post-Civil War society in which the convened members of the fictitious Baltimore Gun Club lament the sudden lack of artillery activities. Their boredom is soon broken by a speech from the club's president, who outlines a bold plan to use a giant cannon to fire a projectile to the Moon. One of the fictional club members awed by the plan is named Tom Hunter. Coincidentally, a very real visionary with the same last name may make author Verne's fantasy come true.

Jules Verne was a true visionary in an era when you need "science fiction," explains John Hunter. "Now, the

problem is that we have too many visionaries and not enough doers." Hunter is standing in his cluttered Southern California office, where he has just drawn a diagram of comparative escape velocities on the blackboard. As president and founder of the Jules Verne Launcher Co., Hunter is combining Verne's vision with his own actions. Quite simply, he intends to use gas-powered launchers as an effective and inexpensive way of propelling satellites into orbit.

Hunter's quest began when he started working at Lawrence Livermore National Laboratory (LLNL) in 1985. One of his first projects at the lab involved the concept of an electromagnetic space launcher. "The



SHARP TEST FACILITY

cost per joule of just about any kind of electric gun is so high that it's basically prohibitive," Hunter says. During a technical discussion at Livermore Lab, it was suggested that he look at the potential of "gas guns," systems that utilize a pump tube filled with heated and pressurized gas to drive projectiles at extremely high velocities. In fact, Hunter's search of the library database revealed that a NASA gas gun had achieved a projectile speed of 6.84 miles per second back in 1966. But he knew that higher velocity was needed.

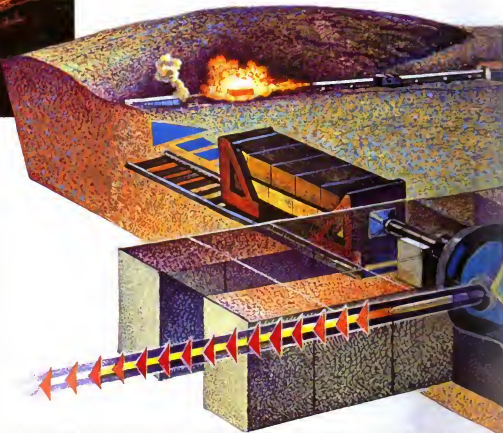
"At that point I knew, just like particle theory, that 99% of the people were just going along the well-worn path because someone had money or a cool idea. But they weren't being rigorous thinkers about solving the problem."

The solution that emerged involved the use of a gas gun with multiple injectors. Hunter's computer simulations suggested that such a system would work very well. "The velocities I was getting to were much higher than had ever been done before with conventional gas guns."

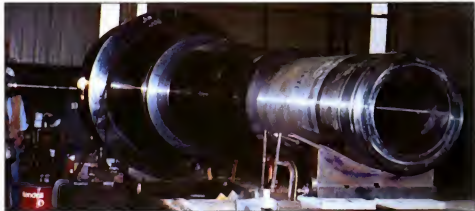
Hunter then conducted a 2-month lab project to demonstrate the anti-tank potential of a single-stage hydrogen gas gun operating at room temperature. "I got 1.5 miles per second. The results were within 1% of my code predictions on six data points." Based on the computer model's accuracy and the quick completion of the project, Hunter was funded for a 3-month effort to develop a 2-stage gas-gun precursor to a space launcher. The effort produced a 10-ft.-long gas gun that achieved a firing velocity of 5 miles per second.

"[That] still exceeds the velocity record for any rail gun ever built," Hunter says. "Gas guns routinely achieve 5 miles per second. That's what's so phenomenal about them. The beauty is that to access space, 4.35 miles per second is where the action really gets hot and heavy. At 4.35 miles per second, you can launch a 10-ton vehicle and get 33% fraction into LEO [low Earth orbit]. If you start with 11 tons, you're going to have 7275 pounds in LEO."

The success of the 10-ft. prototype



The SHARP firing sequence begins with the ignition of a methane gas mixture at one end of the steel pump tube. That explosion drives a 1-ton steel piston down the pump tube, which has been filled with pressurized hydrogen gas. The piston rapidly compresses the gas to 60,000 psi in the high-pressure section (below), destroying a coupling holding the projectile in the attached depressurized launch tube. The projectile is driven down the 4-in.-dia. tube at an extremely high speed and it bursts through a thin plastic sheet covering the end of the gun. All recoil forces are absorbed through the use of three sleds—two 100-ton sleds and one 10-ton sled—mounted on railroad tracks.

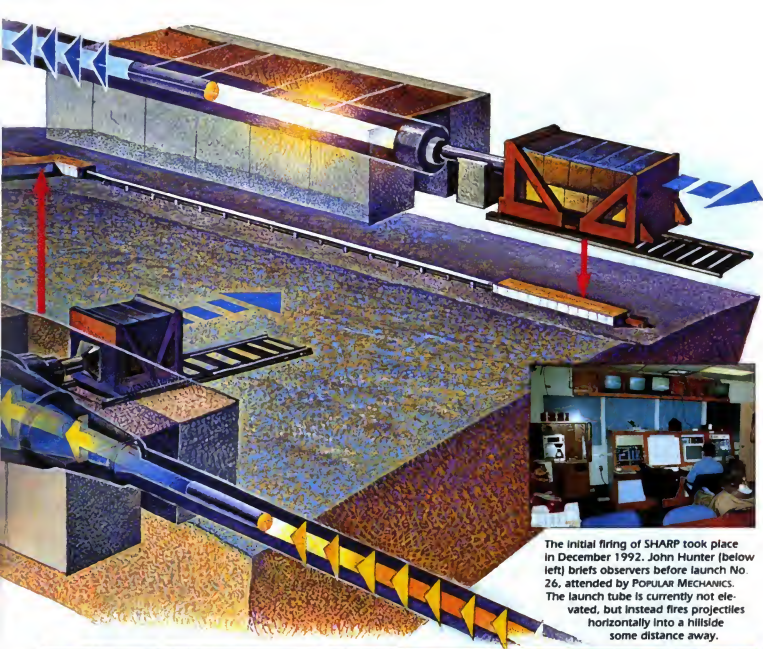


justified additional LLNL research and development funding for a "space gun" project identified as Super High Altitude Research Project, or SHARP. (Hunter chose the name in recognition of the U.S. government's HARP Super Gun project, which was conducted during the mid-1960s with standard powder technology.)

Located at LLNL Site 300, SHARP is the world's largest gas gun. The 425-ft.-long system was built in a unique L-shaped design with a 270-ft.-long combustion section and pump

tube mounted at a right angle to the 155-ft.-long launch tube. The original design was driven by a desire to minimize the height of any supporting gantry that would be required to elevate the tube for space launch.

"SHARP has only gotten to 1.92 miles per second because we're launching fairly big masses and we haven't jacked up the pressures very high," Hunter says. He adds that achieving the requisite 4.35 miles per second is "totally doable," based on both computer-model and lab-gun experience.



The initial firing of SHARP took place in December 1992. John Hunter (below left) briefs observers before launch No. 26, attended by *POPULAR MECHANICS*. The launch tube is currently not elevated, but instead fires projectiles horizontally into a hillside some distance away.



First, Hunter will build and fire a prototype system dubbed the "Micro Launcher." "Our Micro Launcher design is so small that you'll hardly see the projectile—maybe only 50 mils or one-twentieth of an inch," Hunter says. "That sounds crazy, right? I helped build the world's biggest gun," he says jokingly, clearly aware of the irony.

Hunter is also devoting considerable attention to the design of specially hardened satellite packages and has recruited experienced satellite designers for his team of engineers.

They will use the prototype systems to ensure satellite stability as it leaves the launch tube, as well as to address g-force hardening. The largest commercial guns will subject the satellites to 1000 g's for approximately 1 second. Although this is easily met by circuit designs, it may require hardening of components like solar cells or deployable antenna structures.

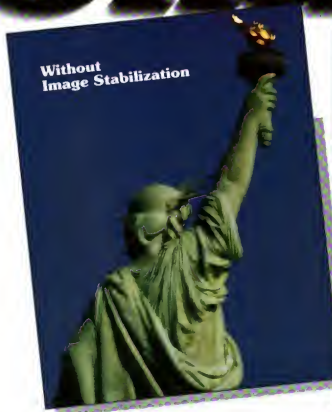
Based on SHARP experience, Hunter's engineers predict that the guns can easily be fired once per working day. Given a rate of 300

launches per year and a payload of 10,000 pounds per launch, the system has the potential of placing approximately 1500 tons a year into LEO. Moreover, at a target launch cost per pound of about one-twentieth of a modern rocket launch, the company estimates a breakeven point between the first 50 and 100 launches.

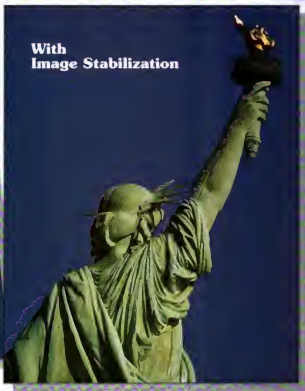
"The house odds wouldn't bet on us," Hunter says. "That's not a condemnation of house odds. That's just the way that the house works. But this is going to happen."

PM

Shake The Shakes



**Without
Image Stabilization**



**With
Image Stabilization**

Canon's new Image Stabilization technology is your key to razor-sharp images.

Folks these days want to get up close and personal to their subjects, so they're turning to higher magnification binoculars, longer lenses for 35mm SLR cameras and higher zoom camcorders. Sure, this equipment can record incredible detail, but there's a drawback. Not only is your subject magnified, but so is hand shake. So shooting photos with a telephoto lens, training binoculars on distant sports action or taking videos with your camcorder lens zoomed out all the way, may give you a fuzzy image instead of a sharp one.



**Canon EF 75-300mm
1/4-5.6 IS USM Lens is the
only lens on the market with
Image Stabilization.**

Sharpening The Image

Canon has addressed this problem by developing a system that's a techno-

Statue of Liberty shot with Canon EF 75-300mm 1/4-5.6 IS USM Lens set at 300mm with ASA 50 film at 1/30 sec for maximum detail.

Photos were taken from a moving boat in choppy water with Image Stabilization turned off (left) and then turned on (right).

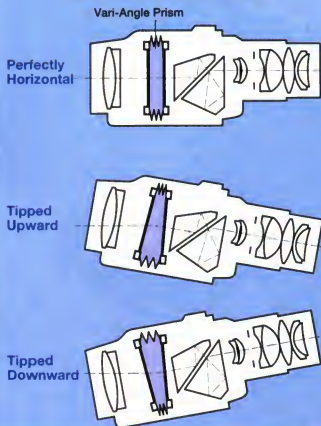
logical breakthrough to neutralize the shakes and give you crystal clear images. It's called Image Stabilization. Originally developed for Canon's 8mm video camcorders, Image Stabilization technology has been integrated into Canon's 12x36 IS binoculars and Canon's EF 75-300mm 1/4-5.6 IS USM lens as well.

Bending The Prism

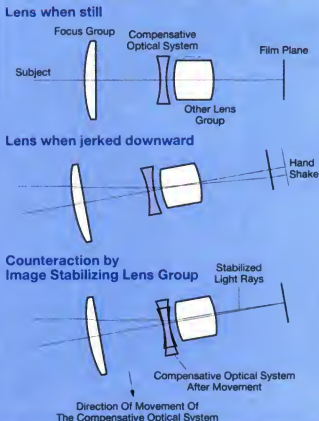
There are actually two Image Stabilization systems. The first, built into Canon's binoculars and camcorders is the Vari-Angle Prism system. It consists of two transparent plates

How Image Stabilization Works

Vari-Angle Prism System for Binoculars and Camcorder



Compensative Optical System for EF 75-300mm f/4-5.6 IS USM Lens



coupled by a super-flexible film and filled with a high-refractive-index fluid. Horizontal and vertical sensors work with a microprocessor to detect unintentional hand movement and other vibrations, and feed corrective signals to tiny motors. These actuators instantly and continuously adjust the shape of the prism to maintain a steady, tack-sharp image.

Canon's 12x36 IS binoculars is the only one in the affordable price range to offer image stabilization. Combine this with a bright image, light weight and an exceptionally distortion-free 67-degree field of view, and it amounts to a new standard in viewing performance.

Canon's newest camcorder, the Hi8 ES6000, uses a remarkable 20X optical/40X digital zoom to bring the action really close. But this camcorder comes packed with features in addition to Image Stabilization. Canon's amazing eye-control focus lets you autofocus simply by looking at the subject you want to be sharp. The same technology lets you operate various camera functions—just by moving your eye.



Canon 12x36 IS Binoculars is the only popular priced binoculars with Image Stabilization.

Dancing Lens

Canon's second Image Stabilization system, called Compensative Optical System, is built into the Canon EF 75-300mm f/4-5.6 IS USM lens—the only lens on the market to offer Image Stabilization. Instead of varying the shape of a prism, the system uses tiny gyros controlled by a built-in microprocessor that senses unwanted camera movement. This triggers signals to a very sensitive magnetic coil surrounding a special group of lens elements. The coil moves the lens group horizontally or vertically to counteract shake and maintain a steady, centered image.

Rock Steady

The Image Stabilization technology not only eliminates unwanted shake, it can even maintain a rock-steady image when viewing or shooting from a moving car or boat and in other challenging situations. Binocular viewing will be more enjoyable, and your photos and videos will be more professional when you shake the shakes.

For more information on Canon products call 1-800-OK CANON.

Also visit Canon at <http://www.usa.canon.com> on the Web.



Canon ES6000 Camcorder with 20X optical/40X digital zoom has Image Stabilization and eye-control focus.

Canon

OUTDOORS





SHAPED SKIS

Hourglass edges take over the slopes.

BY RICH TAYLOR, Outdoors Editor
PM Photo by Scott Markewitz

● You come careening down a double-black-diamond slope in 2 ft. of fresh powder, and instead of sinking in up to your knees, your new, radically shaped skis keep you comfortably floating across the surface. Carve into a turn, and instead of fighting you, your skis swish through a perfect arc—and all you had to do was think about it. Whack a patch of sloppy crud, and instead of chattering out of control, your new skis ride the bumps like a Mercedes-Benz on the freeway. No wonder there's about to be a revolution on the ski slopes.

Whether you call them shaped skis, parabolics, hourglass skis or super sidecuts, these new skis embody the most significant change since safety bindings. The first few commercial designs showed up in ski areas just a year ago and accounted for only 3% of the total ski market in 1996. This winter, 50% of all the skis sold are expected to be shaped skis, some 60 different models from 15 manufacturers.

How did this boom start? Well, about a decade ago, the first snowboards appeared on American ski slopes. The concept was similar to that of a surfboard—use a single wide board with a lot of surface area so it will float on top of the snow.

In 1988, a ski designer named Rupert Huber came up with the Atomic Powder Plus, a pair of skis so wide they floated over the snow like two halves of a snowboard. Simultaneously, ski designers at Elan developed a new style of ski for giant-slam racing. For more than 100 years, all skis had been long and narrow, with a slight bulge at the nose and tail to make them easier to turn. Elan's designers exaggerated this flaring.

These race skis were so successful that in 1991, Elan came out with the SCX, a ski that was somewhere between a split snowboard and giant-slam racer. The SCX was much shorter than a traditional ski, but 25% wider and with extreme sidecuts (the ratio between the width of the waist and the width of the tip). About the only proponents of the new skis were ski schools, who found that students had less trouble controlling a short, fat ski than a long, thin ski. And almost anybody, no matter what their age, condition or experience, could carve a perfect turn by simply weighting an edge.

Surprisingly enough, it took five years for the ski industry to realize that a ski that is easier to control, easier to turn and easier to learn is

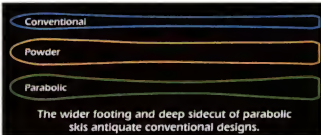
SHAPED SKIS

a ski that could revolutionize the sport. Last season, there were still only 10 different shaped ski models on the market. This season, with 60 models to choose from in a variety of lengths, widths and degrees of sidecut, the shaped ski revolution will finally take off.

How radical are the supercuts? Well, Elan's SCX is one of the most extreme. It measures 115mm across the widest shoulder of the tip, 60mm at the waist and 105mm at the tail. In other words, the ski's tip is just about twice as wide as the area under the skier's boot. What does this do? Two things. The ski floats on deep powder rather than submerging, and in an uncanny way, it seems to automatically pull itself into a turn with only the slightest amount of effort.

The result is a ski that's not only easier for a novice to learn on, but one that—in the hands of an expert—is capable of extreme stunts that few would

that shaped skis must be kept turning most of the time. But honestly, when was the last time you skied straight down an expert slope?



dare to attempt on traditional skis.

As any designer will tell you, every ski is a compromise. A long, narrow ski will be faster and more stable in a straight line than a short, wide ski, but harder to turn. A short, wide ski will be comparatively slow, but quick-cornering. The only downside is

Even the longest shaped skis are much shorter than traditional alpine skis and, consequently, less stable—about the longest you'll find are 200cm and most skiers are using 160cm or 170cm skis. Typically, the more radical the sidecut, the shorter the ski for a given skier. This is because the wide tip and tail add surface area, so a short, wide ski will support the same load as a long, narrow ski.

There are also factors like longitudinal flex, torsional rigidity and camber to take into account. The width of the waist—where the skier's weight rests most heavily—is also crucial. A wider waist floats more easily over the snow, while a narrow waist with greater width in tip and tail makes turning easier. The ratio between the width of the waist, tip and tail also determines a "natural" curve on which the ski will want to turn.

Because the revolution is so new, there are no rules. Shaped skis come in all sorts of profiles, aimed at everyone from students renting their first skis at a ski school to professional grand-slam racers. But almost every manufacturer sells a model meant as an all-around ski for a variety of conditions. For most recreational skiers, something like the popular K2 Two or K2 Three will prove to be a versatile ski they can use in almost any condition or locale—skis they won't outgrow as they become more proficient.

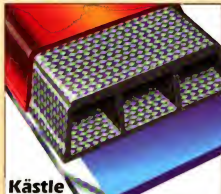
In addition, shaped skis are sold differently from traditional skis. Most shaped-ski manufacturers offer only two to four lengths, rather than the dozens of lengths 5cm apart customarily offered by traditional ski shops.

For example, K2's Two comes only in 158cm, 168cm, 178cm and 188cm lengths. Shaped skis are so forgiving that there's no need for the custom tailoring that is characteristic of old-style skis.

Prices of shaped skis range from around \$395 for a pair of K2 Twos to \$840 for carbon-fiber Goode Excesses. This puts them at the premium end of the ski market, but certainly not out of reach for even the most casual recreational skier. Are they worth it? You bet. Intermediate skiers who drifted away because they couldn't get past the infuriating plateau of carved turns are now zooming all over the slopes on hourglass skis, leaving perfect wakes. Shaped skis are so much easier to control that knee injuries are down, too. And that puts the fun back in skiing. Viva la revolution!

FM

Radical Construction



Kästle

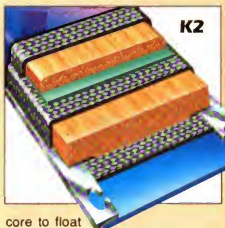
• Instead of traditional wood or fiberglass laminates, shaped-ski manufacturers are trying all sorts of new ideas. The most conventional are fiberglass skis with surfboard-like foam cores. But that's just the beginning.

Kästle of Austria—now owned by Benetton—sells a number of ski models created from hollow fiberglass tubes. Three tubes run parallel the length of the ski and are bonded together. The ski's upper body is translucent, so you can actually see the tubes beneath the skin. In addition to being neat to look at, Kästle's

skis also weigh 30% less than comparable fiberglass-laminate skis.

Rossignol's Dualtec has a typical laminate construction on the bottom, but with an energy-enhancing shell on the top with a separate sidewall that joins the top and bottom to the central core. The idea is that the ski can be both stiff enough for directional stability but flexible enough to follow the contours of the mountain.

K2's Integrated Suspension System, or ISS, has two wood cores individually wrapped with triaxial braided fiberglass and stacked on top of each other. The two cores are separated by a flexible layer that allows the upper



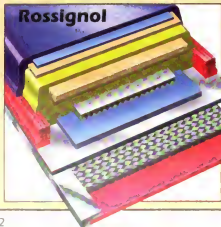
K2

core to float over the lower core in wide-radius turns, but stiffens up in tight turns for better control.

One step further is the ACX system, built around piezoelectronic ceramic fibers embedded in the top of the ski. As the ski bends, the piezos generate an electrical charge that a computerized controller hidden in the ski tip feeds back into the piezo,

causing the vibrations to cancel each other. This provides a smoother, more controlled ride.

—R.C.T.



Rossignol

DIGITAL CAMERAS GROW UP

These cameras will change the way you capture memories, thanks to their higher quality and new capabilities.

BY JOSHUA SHAPIRO



● On September 13, 1996, Mark and Linda Cook had a new baby, Sam. Critical information—such as whether Sam looked more like his father or mother—was available within hours to their whole family in New Jersey and New York, and to friends in California and Rhode Island.

They all knew what the newborn looked like because the father took photos of the child using a new, filmless Kodak digital camera. By downloading the exposures into his laptop computer, embedding them in a new Kodak application program called Picture Postcard and sending the photos and birth announcement over the Internet to accounts on America Online and CompuServe, Mark Cook helped his far-flung circle of family and friends to feel close to the birth experience.

It was a simple procedure for Cook, a product manager for Kodak. Most other photographers would have had a more difficult time. Nevertheless, both baby and digital photography are doing well,



OLYMPUS D-200L

This \$600 digital camera has the look and feel of a traditional point-and-shoot model.

RICOH RDC-1



widely varying price points are available worldwide. Our chart below shows the 27 cameras that are scheduled to be available for less than \$3000 in the United States by year's end.

Fostered by the maturing electronics industry, digital photography is enabled by low-cost hardware, including personal computers; digital signal processors; mass-produced camcorder photo sensors; highly integrated, low-power-consuming CMOS silicon circuitry; tiny and rugged PC-card disk drives and flash-memory storage devices.

Besides hardware, digital photography also has benefited from broad industry advances in efficient image processing and high-speed image-compression algorithms, as well as desktop graphics-processing software like Adobe Photoshop. Finally, without a wide audience familiar with computers, or at least willing to approach them without fear, digital photography in its current form would not have been possible.

A digital camera might look like a traditional point-and-shoot camera or a high-end SLR, or like some strange space-age gizmo. They all have a lens of some sort, but the viewfinder might

thank you. Judging by the recent spate of announcements concerning new corporate alliances, lower-priced digital cameras and photographic software applications, digital photography is embarking on a period of rapid growth. Once only a novelty for the technology-curious, today's market is fueled by the widespread availability of personal computers in homes and businesses and the explosion of multimedia activity on the World Wide Web. Digital photography has one fundamental advantage over traditional silver-halide film-based photography—it removes the barriers of space and time from using and enjoying pictures.

Like the Polaroid self-developing photos that became popular years ago, a digital photograph can be displayed almost instantly. But digital photographs can be duplicated without processing and can be sent via modem and wire rather than by mail or courier service. It's no wonder that news photographers were the first market for electronic photographs a decade ago, when Sony shipped its consumer-grade Mavica (short for magnetic video camera). Primitive by today's standards, it took analog still movie frames and stored them on nonstandard 2½-in. floppy disks—all for a mere \$3500.

After several generations of improvement by many companies, digital photography is forging beyond this niche market. About 100 cameras at

Digital Camera Specifications

Manufacturer	Model	Price	Image Size	Internal RAM (MB)	Picture Capacity	Removable Storage	PC Connection Method	Lens Focal Length (35mm Equiv.)	Focus Method
Apple	Quick Take 150	\$599	640x480	1	16/32	None	Serial	50mm	Fixed
Canon	PowerShot 600	\$949	832x608	1	18	PCMCIA Type I/II/III	Parallel port docking station	50mm	Auto
Casio	QV 10A Plus	\$699	480x240	2	96	None	Serial	60mm	Fixed
Casio	QV 30 Plus	\$999	480x240	2	96	None	Serial	46/103mm	Fixed
Casio	QV 100	\$650	640x480	4	64/192	None	Serial	40.5mm	Fixed
Chinon	ES 3000	\$1095	640x480	1	5/10/40	PCMCIA Type I/II	Serial	38-114mm	Auto
Connectix ¹	Color Quickcam	\$199	640x480	None/tethered	n/a	None/tethered	Serial ² parallel	47mm	Manual
Dakota Digital	DCC-9500	\$699	640x480	1	5/10/40	PCMCIA Type I/II	Serial	38-114mm	Fixed
Dycam	4	\$795	496x365	1	8/24	None	Serial	70mm	Fixed
Dycam	10-C	\$899	640x480	1	5/40	PCMCIA Type I/II	Serial	37-111mm	Auto
Epson	PhotoPC	\$499	640x480	1 ³	16/32	None	Serial	43mm	Auto
Fujifilm	DS220	\$1049	640x480	None	n/a	PCMCIA Type I/II	Serial	36/72mm	Fixed
Fujifilm	DS7	\$699	640x480	2 ¹	30/60	PCMCIA Type I/II	Serial	38mm	Auto
Kodak	DC20	\$350	493x373	1	8/16	none	Serial	47mm	Fixed
Kodak	DC25	\$499	493x373	2	14/29	PCMCIA Type I/II	Serial	47mm	Fixed
Kodak	DC40	\$700	756x504	4	48/99	none	Serial	42mm	Fixed
Kodak	DC50	\$1000	756x504	1	71/122	PCMCIA Type I/II	Serial	37-111mm	Auto
Olympus	D-200L	\$599	768x480	2	20/80	None	Serial	36mm	Fixed
Olympus	D-300L	\$899	1024x768	6	30/120	None	Serial	36mm	Auto
Pixera ⁴	Personal	\$599	1280x1024	None/tethered	n/a	None/tethered	PCI or PCMCIA	35mm	Fixed
Pixera ⁴	Professional	\$1195	1280x1024	None/tethered	n/a	None/tethered	PCI or PCMCIA	36mm	Fixed ⁵
Polaroid	PDC-2000/T	\$2995	1600x1200	None/tethered	n/a	None/tethered	SCSI	38mm	Fixed
Ricoh	RDC-1	\$1699	768x576	None	n/a	PCMCIA Type I	Serial	50-150mm	Auto
Ricoh	RDC-2	\$770	768x576	2	19/38	PCMCIA Type I/II	Serial	55mm	Auto
Sony	DKC-ID1	\$1795	768x576	None	n/a	PCMCIA Type II	SCSI	38-460mm	Auto
Sony	DSC-F1	\$850	640x480	4	30/50/108	None	IRDA/Serial	35mm	Auto
StarDot ¹	WinCam.One	\$199	640x480	None/tethered	n/a	None/tethered	Serial	50mm	Fixed

1. Still or motion camera. 2. Requires connection to keyboard port for power. 3. Expandable. 4. 2MB removable solid-state memory included with camera holds 30 or 60 images.

5. Accepts C-mount lenses.

be optical or a small LCD display. With a traditional camera, the film acts as the sensor that detects the image being formed by a lens, as well as the storage medium that holds the light exposure. In digital photography these functions are separate. In place of the light-sensitive silver-halide chemicals, a digital camera exposes an electronic CCD (charge-coupled device) array that accumulates electric charge proportional to the amount of light received. A red-green-blue color filter is generally patterned over the CCD (in stripes or a checkerboard) to add color sensitivity to the device.

The CCD outputs an analog signal one row at a time—not surprisingly, much like a TV scan line. Analog circuitry filters and enhances this output wave form to create the color channels, which are then converted by an A/D converter to a digital bitstream.



**CANON
POWERSHOT 600**

A specialized microcomputer called a DSP (digital signal processor) cleans the image, corrects the color, formats the data and compresses the image to save storage capacity. Finally, the formatted and compressed picture file is stored in some form of nonvolatile memory, usually flash memory.

Once they are safely stored in

nonvolatile memory, digital pictures are generally transferred to a PC for viewing, editing, outputting to a print device or transmission to another PC. Here again, digital photographs shine compared to the old-fashioned silver-based images. Digital images can be cropped, enlarged, enhanced or printed—without the money and expertise required to use a darkroom. Digital prints offer more control over the final image. Contrast and color balance are easily shifted, and sophisticated manipulation, impossible with film, is also possible. Also, as with

Cook's baby pictures, digital images can be distributed around the world quickly and easily.

All of this is done completely without film costs or the expenses associated with environmental regulations. This brings us to the main impetus behind some of the most important digital-photography announcements and introductions. Should digital photography replace film altogether, no camera company wants to be left out. Until recently, most manufacturers came up with new models without giving much thought to how, or by whom, they should be used. Their view was, "We have the technology—let the market decide." But now, markets are gradually shaping up into four areas.

The first, and oldest, is photojournalism. News photographers are still



SONY DSC-F1

willing to buy \$10,000 to \$20,000 cameras using high-quality Nikon or Canon 35mm lenses so they can get photos back to their publishers from remote war zones, accident and disaster sites, or just the old campaign trail.

The second major use of digital photography also hinges on the adage "time is money." The graphics and prepress markets and the photographers that produce pictures for catalogs and magazine advertising are moving to digital photography for the speed of image editing and to meet shrinking production schedules. Digital cameras allow photographers to preview the result before striking the set for the product shot. For them, that assurance is worth the \$10,000 to \$41,000 that high-quality graphics cameras cost.

Commercial-grade documentation encompasses the next major set of applications. Nonphotographic professionals, whose jobs require saving views of places or things, are a major market for this new form of photography. Insurance claims adjusters, real estate agents, building contractors and law enforcement officers all need low-cost, medium-quality snapshots. Digital cameras in the \$1000 price range are adequate for taking pictures of dented enders and accident-scene tire-skid marks, or views from front porches. Digital photographs for documentation are stored without



KODAK DC20

You Say You Want Some Resolution

● Even the best consumer-priced digital still camera falls far short of the cheapest 35mm film camera—which can produce pictures with the equivalent of 150 million pixels for luminance and color information.

No professional photographer would shoot his work with any of the cameras in our list. And any snapshot shooter who got prints back from a 1-hour photo lab that looked like the photos these cameras produce would demand his money back. So what are these cameras for, and why would anyone spend hundreds or thousands of dollars for one?

In some applications, these cameras can produce acceptable quality. Most of the cameras in our list can capture an image with a resolution of 640×480 (about 300,000) pixels. On a computer monitor, that's a stand-

ard VGA image. And on the screen, a digitally captured photograph looks pretty good. Look closely—or print it



on a high-resolution printer—and problems become evident. The CCD that captures the image might have a resolution of 640×480 , but those pixels must be used for both color and luminance information. That's a compromise that affects quality.

Fortunately, sophisticated software can do a surprisingly good job of creating the information that is missing from digital photographs, and correcting their color. So even a low-resolution picture can be pleasant to look at as long as your expectations aren't too high.

Almost all digital cameras give shooters some control over the captured resolution. For example, the Olympus D-200L, which was used to take the snapshots at left, offers two resolution settings. One allows 20 photos to fit in the 2MB internal memory, and one (inset) allows up to 80. —Brian C. Fenton

bulky files, quickly retrieved with sophisticated database programs and easily transmitted from remote locations, allowing speedy verification, identification or approval.

Finally, consumer applications for desktop and Internet publishing applications are fueling growth in the sub-\$1000 camera range. (See "A Desktop 'Photo Lab,'" page 74.) Newsletters, fliers, Web pages and photo identification can all use small, relatively low-grade images that the new, less expensive cameras make available. Some low-end cameras are even being used for commercial applications, such as used-car listings or low-cost catalog production.

Despite these advantages and the market growth, digital photography is not poised to supplant silver-based photography altogether. Digital quality still doesn't rival the richness that fine-arts photographers achieve using

large-format cameras and platinum or palladium prints. And acceptable quality from digital in less demanding applications comes at a price that's too high. Getting the quality of a 35mm slide from a professional camera would require a digital camera costing \$15,000 to \$30,000. Also, just to get the equivalent results of a simple and inexpensive point-and-shoot camera would require a digital camera costing \$1000 to \$3000.

Another potential turnoff is that digital camera users must have substantial gumption to figure out all the configurations, options and interfaces to knit

together a workable path between camera, application software and e-mail options. Finally, industry standards are still shifting and evolving,

especially in the areas of memory cards, camera/PC interface connectivity and picture interchange formats. The recently announced FlashPix format promises to bring some much needed standardization to the imaging industry.

Nevertheless, manufacturers of these cameras will need to make their wares significantly more affordable and more user-friendly for digital photography to reach a healthy and mature adolescence. **TM**



Digital Film



● Camera memory—which serves as the film for digital cameras—is one area where manufacturers still haven't reached a consensus. However, to keep prices down, all manufacturers would like to



sell cameras without built-in memory.

Today, three incompatible technologies are vying to replace the standard PCMCIA memory card: CompactFlash (developed by San Disk, which produces Kodak's Picture Cards), Miniature Card (developed by Intel) and SFFDC, or Solid State Floppy Disk Card (developed by Toshiba). Although mutually in-

compatible, all three of these miniature memory cards can plug into special PCMCIA adapters.

CompactFlash seems to have the edge because of Kodak's support, and also because it is based on the ATA disk-drive interface standard. Kodak also sells a card reader that accepts both Picture Cards and standard PCMCIA cards. It plugs into a standard PC printer port for image transfer.

—B.C.F.



Europe's classic sports sedans – BMW 328i, Mercedes C280 and Volvo 850 turbo –

The New 1997
SUBARU 2.5 GT

wield incredible horsepower. The new Subaru 2.5 GT sports sedan, however, not only possesses plenty of horsepower, but amazing superpowers as well. Like the unbelievable traction of full-time All-Wheel Drive. The superior stability of a horizontally opposed engine. And the remarkably smooth ride of an optimally tuned suspension.

Together they form the Subaru All-Wheel Driving System. A system that senses whatever dangers lurk ahead, automatically shifting power to the wheels that need

quite a punch, thanks to its powerful low-end torque. For the expanded version of this action figure's resume, just call 1-800-WANT-AWD, visit our website at <http://www.subaru.com>

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YOU'LL SWEAR YOU
HAVE SUPERPOWERS.**

it most. So you can hold your ground against a menacing cast of archenemies: rain, snow, sleet and gravel. The available 5-speed Subaru 2.5 GT also packs

or, better yet, drop by your nearest Subaru dealer and take the amazing 2.5 GT for a test-drive. And in no time you'll find yourself doing things you never dreamed humanly possible.

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COMPARISON TEST

BADGE ENGINEERING THE SUVs

Despite different names,
many SUVs are the same
beneath the skin.



Bravada



MOUNTAINEER





RODEO

PASSPORT



TROOPER

SLX



BY SCOTT OLDHAM, West Coast Editor; PM Photos by Greg Jarem

● Look closely. Are there eight trucks in this test, or only four? Right here, before your very eyes, badge engineering can turn one vehicle into two. Or three.

Badge engineering. That's the term used in industry circles to indicate when essentially the same product is sold under two—or more—different names. The only thing changed—or re-engineered—is the badge.

This sleight of hand isn't limited to just trucks. Consider the Dodge Intrepid/Eagle Vision. Or Ford Crown Victoria/Mercury Grand Marquis. Don't assume it's limited to the auto industry, either. Notice how that Kenmore washer looks just like a Whirlpool.

Deceiving? Definitely. Unethical? Maybe. Smart business? You bet. Slapping your badge on somebody else's product allows you to get it to market much faster, with far less financial investment than designing, testing and building the thing yourself from scratch. Minimal risk, minimal investment, maximum financial efficiency. Hey, it's the fiscally conservative '90s.

This compact sport/utility vehicle test consists of four sets of trucks that are sold under different nameplates but are virtually identical: the Chevrolet Blazer and Oldsmobile Bravada, Ford Explorer and Mercury Mountaineer, Isuzu Rodeo and Honda Passport, and

BADGE ENGINEERING THE SUVs

the Isuzu Trooper and Acura SLX. We tested these twins on road, track and trail to find out how they differ, if at all.

If you're already hip to badge engineering, you may have noticed there are absentees. A GMC Jimmy (same as the Blazer and Bravada) is missing because a properly equipped vehicle was unavailable. The Geo Tracker/Suzuki Sidekick tandem is being saved for a future mini-SUV test. The Nissan Pathfinder/Infiniti QX4 team was lined up and we wanted to include them. In fact, we even postponed this test a month to accommodate the new Infiniti. But a week before we were ready to test, Infiniti called to say that they're still working the bugs out of the QX4's sophisticated all-wheel-drive system, so no truck.

Chevrolet to be mechanically similar to the Oldsmobile and just as luxurious. Simply order up a 4-door Blazer LT model and pay extra for the

The Bravada comes only with four doors, four speeds and all-wheel drive (with no 4-Low). The Blazer, however, is available with two or four doors,



BLAZER

sophisticated, road-reading all-wheel-drive SmarTrak system, leather seats, trip computer with compass and the power glass sunroof.

Now pay attention. This is where it gets a bit confusing. The Oldsmobile, which comes only one way,

uses suspension settings identical to the Blazer's optional Z85 Touring suspension. Chevy, however, won't sell that suspension with all-wheel drive, as on the Olds. The awd system on the Blazer is always packaged with the very soft Premium Ride suspension. However, if you want a softer-riding Olds Bravada, you're out of luck.

four (automatic) or five speeds (manual) and 2-, 4- or all-wheel drive. The Blazer is even available as a high-riding, wide-stance serious off-road machine ready for the Rubicon.

At the test track, the stopwatch saw no difference at all between the two. The more softly sprung Chevy leaned more when cornering hard and felt more like a Caddy than a Corvette. The Blazer and the Bravada accelerated and handled with a sameness of twins doing the Macarena.

But when it comes to braking, the Chevy, which had rear drum brakes, did noticeably worse than the Olds, which was equipped with rear discs. Overall, both trucks stopped poorly, weaving around during hard braking.

We have only praise for the torquey 190-hp 4.3-liter V6 that powers both trucks. It moved both from zero to 60 mph and through the quarter mile



Bravada

Here's what we found out about the vehicles we tested.

Chevrolet Blazer/Oldsmobile Bravada

The Oldsmobile has a floor shifter while the Blazer's is on the column. Other than that, with the Blazer's extensive options list, you can equip the

SPECIFICATIONS AND DIMENSIONS

MANUFACTURER/ MODEL	BASE PRICE/ PRICE AS TESTED	ENGINE TYPE/SIZE (liters/ci)	ENGINE HP, NET/ TORQUE (ft.-lb.)	TRANS./4WD GEARING/ SHIFT TYPE	WHEELBASE/ LENGTH (in.)	TRACK F/R (in.)	WTH/WT/ GROUND CLEAR. (in.)	HEADROOM/ LEGROOM/ HIPROOM (in.)	EPA INTERIOR/ CARGO VOL. (cu. ft.) (rear seat up/down)	REAR DOOR(S)/ GLASS/FULL-SIZE SPARE TIRE	CURB WGT./WGT. WGT./HP RATIO (lb./hp)
Acura SLX Premium	\$38,000/ \$39,373	sohc 24v V6/ 3.2/193.0	190@5600 rpm/ 188@4000 rpm	4A/2H, 4H, 4L/ manual, on-the-fly	108.7/ 183.5 ¹	59.6/ 59.8	72.4/72.2/ 8.5	F: 39.4/40.8/53.7 R: 37.8/39.1/53.5	102.3/ 43.7/85.3	70-30 split/integral/ left-door-mounted	4640/ 24.4
Chevrolet Blazer LS	\$23,252/ \$27,167	ohv V6/ 4.3/262.0	190@4400 rpm/ 250@2800 rpm	4A/2H, 4H, 4L/ electnc, on-the-fly	107.0/ 181.2	57.2/ 55.1	66.5/67.0/ 7.5	F: 39.7/42.4/52.0 R: 38.6/36.1/51.3	101.8/ 37.3/74.1	dropgate/liftglass/ underbody-mounted	4023/ 21.2
Ford Explorer XLT	\$26,225/ \$29,635	sohc 12v V6/ 4.0/245.0	205@5250 rpm/ 245@3000 rpm	5A/awd, 4H, 4L/ electnc, on-the-fly	111.5/ 188.5	58.8/ 58.6	70.2/66.8/ 6.7	F: 39.8/42.4/51.9 R: 39.3/37.7/51.7	103.8/ 42.6/81.6	liftgate/liftglass/ swing-out carrier	4166/ 20.3
Honda Passport EX	\$29,030/ \$30,842	sohc 24v V6/ 3.2/193.0	190@5600 rpm/ 188@4000 rpm	4A/2H, 4H, 4L/ manual, on-the-fly	108.7/ 184.8 ¹	57.7/ 57.9	68.5/66.3/ 8.5	F: 38.0/42.5/55.5 R: 38.0/36.0/55.5	96.0/ 35.0/74.9	dropgate/liftglass/ swing-out carrier	4137/ 21.8
Isuzu Rodeo LS	\$28,410/ \$29,485	sohc 24v V6/ 3.2/193.0	190@5600 rpm/ 188@4000 rpm	4A/2H, 4H, 4L/ manual, on-the-fly	108.7/ 184.6 ¹	57.7/ 57.9	68.5/66.3/ 8.5	F: 38.6/41.2/55.5 R: 38.0/34.5/55.5	93.2/ 35.0/74.9	dropgate/liftglass/ swing-out carrier	4105/ 21.6
Isuzu Trooper LS	\$31,570/ \$35,655	sohc 24v V6/ 3.2/193.0	190@5600 rpm/ 188@4000 rpm	4A/2H, 4H, 4L/ manual, on-the-fly	108.7/ 183.5 ¹	59.6/ 59.8	72.2/72.2/ 8.6	F: 39.4/40.8/53.7 R: 37.8/39.1/53.5	104.9/ 43.7/85.3	70-30 split/integral/ left-door-mounted	4315/ 22.7
Mercury Mountaineer	\$29,240/ \$31,905	ohv V6/ 5.0/302.0	210@4500 rpm/ 280@3500 rpm	4A/awd/ none	111.5/ 188.5	58.8/ 58.6	70.2/66.7/ 6.7	F: 39.8/42.4/51.9 R: 39.3/37.7/51.7	103.8/ 42.6/81.6	liftgate/liftglass/ underbody-mounted	4396/ 20.9
Oldsmobile Bravada	\$30,285/ \$31,705	ohv V6/ 4.3/262.0	190@4400 rpm/ 250@2800 rpm	4A/awd/ none	107.0/ 180.9	56.6/ 55.1	66.5/63.7/ 7.7	F: 39.7/42.4/53.1 R: 38.6/36.1/51.4	100.4/ 37.3/74.1	liftgate/liftglass/ underbody-mounted	4023/ 21.2

*With spare 1. Best E.T. and highest speed may be attained separately. 2. Best time from a steady state 40 to 70 mph. 3. Best speed achieved weaving through eight cones 75 ft. apart. Speed provides index of transient response.

much quicker than even the V8-powered Mercury Mountaineer.

The interiors of both trucks work well, but the Olds has the advantage

An Explorer can have two or four doors and one of a whole laundry list of trim levels, from the base XL to the packed-to-the-gills Limited. It can

ered by the optional brand-new 4.0-liter sohc V6 and Ford's new 5-speed automatic—available only with this engine. The V6 makes 205 hp and a strong 245 ft.-lb. of torque at 3000 rpm. Sure, the V8 has a much stronger bottom end, but thanks to the close ratios of the 5-speed, the V6 Explorer left the V8 Mountaineer in the dust.

That quick drivetrain response and the Explorer's stiffer suspension make it much sportier and more fun than the Merc—on- and off-road. The Mercury's shocks and springs are tuned softer. They allow more brake dive than we care for and too much body motion during cornering and over uneven roadway.

But on the test track, surprisingly, the two trucks were identical. The Mountaineer's extra ride motions do not prevent it from matching the stiffer Explorer's performance



thanks to its standard leather and touch of wood trim.

Conclusion: The slight variations do not result in a discernible performance difference either on- or off-road.

Ford Explorer/ Mercury Mountaineer

Ford dealers sold more Explorers last year than any other dealer sold any other sport/utility. Mercury dealers wanted a piece of the action. Enter the Mountaineer.

All Mountaineers are equipped with leather seats, a condition-reading full-time awd system, a 210-hp 5.0-liter V8 and a 4-speed automatic.

Careful and generous use of the Ford Explorer's options list will build a truck that is similar, but not identical, to the Mercury. The difference once again falls in suspension settings and equipment availability.



also have one of three engines, including the V8, and if you can live with a 160-hp 4.0-liter V6, a 5-speed manual.

Our Ford Explorer XLT was pow-

through the slalom, emergency lane-change or skidpad tests. Yet, the firmer Explorer never rode harshly and never sent potholes up through

TEST RESULTS

STEERING TYPE/RATIO (overall)	TURNING CIRCLE (ft.)	WHEEL SIZE AND TYPE/ TIRE SIZE	BRAKE SYSTEM TYPE/SIZE (front/rear)	FUEL ECON. (mpg) EPA CITY/HWY PM TEST (avg.)	ACCEL. ¹ 0-60 MPH (sec.) 1/4-MILE (sec./mph)	PASSING ACCEL. ² 40-70 MPH (sec.)	BRAKING 60-0 MPH (ft.)	525-FT. ³ SLALOM (mph)	200-FT. ⁴ SKIOPAD (lateral g)	LANE ⁵ CHANGE (mph)	SOUND (dBA) 100/FULL THROTTLE STEADY 60 MPH
power recirc. ball/15.6:1	38.1	16x7-in. alloy/ 245/70R16	disc/disc ABS/ 11.0-in. vented/12.3-in. vented	14/18 13.6	11.7 18.3/77.5	10.3	149	40.0	0.84	48.0	51.3/79.8 72.3
power recirc. ball/13.0-16.0:1	39.5	15x7-in. alloy/ 235/70R15	disc/drum ABS/ 10.5-in. vented/9.5-in.	16/21 16.6	9.9 17.2/78.1	8.4	154	41.7	0.66	44.8	48.9/79.0 71.7
power rack & pinion/17.0:1	37.3	15x7-in. alloy/ 235/75R15	disc/disc ABS/ 11.28-in. vented/11.22-in. solid	15/19 16.4	9.3 16.8/82.4	7.1	136	42.7	0.82	47.1	52.7/78.0 72.0
power recirc. ball/19.5:1	40.9	16x7-in. alloy/ 245/70R18	disc/disc ABS/ 11.0-in. vented/12.3-in. vented	15/18 14.5	11.7 18.2/74.7	9.7	130	38.3	0.83	47.8	58.0/79.8 74.0
power recirc. ball/19.5:1	38.1	16x7-in. alloy/ 245/70R16	disc/disc 11.0-in. vented/12.3-in. vented	15/18 14.6	11.1 17.9/75.5	9.1	149	41.4	0.66	43.6	51.9/79.4 72.8
power recirc. ball/19.6:1	38.1	18x7-in. alloy/ 245/70R16	disc/disc ABS/ 11.0-in. vented/12.3-in. vented	14/18 13.7	11.3 18.4/74.5	9.5	137	39.3	0.85	45.8	53.0/79.6 71.8
power rack & pinion/17.0:1	37.3	15x7-in. alloy/ 235/75R15	disc/disc ABS/ 11.28-in. vented/11.22-in. solid	14/18 15.5	10.2 17.4/76.3	8.5	139	42.1	0.82	46.7	55.7/80.3 71.5

its cloth seats to your back side.

Oh, the seats. Both trucks use the same design with a very long seat bottom, which all of our test drivers found

Isuzu Trooper/ Acura SLX

The differences between these two boil down to image and the dealership



TROOPER

extremely uncomfortable. The engineer who designed these seats must have had very long thighs because the seat bottom actually dug into our calves. The rest of the interior is right on—these were the only trucks with rear a/c vents and radio controls.

Both trucks exhibit good braking characteristics, and both steer with the direct response and feel that used to be reserved for cars. Good cars.

Conclusion: If a carlike SUV is on your wish list, one of these two is the way to go. Although only a different grille and trim separate the Explorer and Mountaineer on the outside, there are suspension specifications and availability differences underneath.



SLX

experience. Because in reality, there is no—none, zero—mechanical difference between these two vehicles. Acura buys a loaded Trooper from Isuzu, puts its name on it, adds several

grand to the price and reaps the benefits. Ask yourself this: Is working with an Acura dealer, who practically invented customer satisfaction, instead of an Isuzu dealer worth a few grand?

These two trucks are more alike than two John Grisham courtroom thrillers. But we found slight performance differences between them in braking and handling, which we attribute to tires (the Acura wore Bridgestones and the Trooper wore Goodyears) and the fact that the Trooper we tested arrived with only 100 miles on its odometer.

Hop in either, and the name on the steering-wheel hub is your only clue as to which truck you're in, unless you notice the smattering of wood.

Both the Trooper and SLX drive more like trucks than any of the other six vehicles on these pages. Pushing either through the emergency evasive-maneuver test or just hustling one up a freeway on-ramp is like pushing Jello uphill. The suspension

Big Twins

● Badge engineering is not limited to compact SUVs. All of the full-size sport/utilities, which are selling faster than pepperoni cheesesteaks in New Jersey, have a lookalike. It



You can say "potato" or "potathto." Both Chevy [top] and GMC say "Suburban."

seems that no good truck will go unduplicated. So while the subject of our test was the compact sport/utility segment, we thought you'd want to know about the big guys, too.

Chevrolet and GMC each market a version of the Suburban. It's even called the Suburban by both divisions. Now that's the ultimate in badge engineering. The two trucks have the same everything, from the suspension settings to the seat upholstery, including an optional 290-hp 7.4-liter ohv V8 that puts out 410 ft.-lb. of torque and could tow Delaware to California. The big-block Chevy lives.

GMC and Chevy also share what has been called the "Baby 'Burban." Chevy calls it the Tahoe, and GMC named it the Yukon. Same truck. Both are offered in 2- and 4-door models. Both use the same suspension tuning, the same 250-hp 5.7-liter V8 and the same optional 6.5-liter turbodiesel V8.

There's talk that next year, the GMC trucks will get a new, more opulent interior and some unique styling cues to separate them from the

Chevs and justify their premium-truck marketing strategy.

Lexus's SUV, the LX 450, is really a Toyota Land Cruiser, which has been around in its current iteration for six years. More expensive even than the already pricey Land Cruiser, the LX



Toyota dealers sell it as the Land Cruiser, but Lexus dealers call it LX 450 [top].

is soft, the body leans way over, the steering is heavy and slow. In the rough stuff, though, they handled whatever we threw at them, and they seemed to enjoy it, unlike some of the other vehicles in this test. It was clear that the engineers who developed these vehicles originally expected them to be used almost exclusively off-road. But on the road, these two vehicles are, well, trucks.

Contrary to a recent article in *Consumers Reports*, while both the Trooper and SLX did feel tall and tippy during hard cornering and accident-avoidance maneuvers, neither of them lifted a tire off the ground.

The same V6 engine in

think it's about \$4000. We say buy the Trooper and spend the four grand on a couple of full-suspension Cannondales. Then go off-roading.

on the Rodeo) and wore Goodyear Wrangler tires, which have a slightly softer sidewall than the Bridgestone Duelers wrapped around the Isuzu's



PASSPORT

wheels. Tires are not specified for each vehicle, however. It's pure luck of the draw.

This tire variance, and the fact that the '97 Isuzu Rodeo showed up with only 104 miles on the odometer, may explain the significant differences in the performance, ride and handling of these two trucks. Our explanation is that manufacturing and assembly tolerances can vary between two mechanically identical machines, making them perform differently.

As expected, the Honda's antilock brakes made stopping much easier, but the Rodeo held its own—stopping from 60 mph in a shorter distance than the Chevy Blazer, which is equipped with ABS.

Power for the Passport and Rodeo comes from the same drivetrain that moves their larger brothers. But in the Rodeo and Passport, the V6 is much happier because it has less mass to move. The acceleration times are still nothing to brag about, but these trucks definitely feel lighter on their feet than the Trooper and SLX.

The interiors of the Rodeo and the Passport are as alike as their engines. Neither is as slick inside as the Mountaineer, but they're both better ergonomically than the Trooper and SLX, and much more sporty and carlike thanks to lighter, quicker steering, a firmer suspension and a great seating position. Both trucks are saddled with only one cup holder, and it's poorly placed.

Conclusion: It's easy to see why the Rodeo is the best-selling import sport/utility. It is one of the sportiest vehicles in this test, and still a pretty good value. The Passport is the same vehicle for a thousand more, which makes it not such a good value—unless you want to own a Honda. **PM**



RODEO

both was satisfactory, but not great. It often felt taxed by the load, and the acceleration times show it.

Conclusion: What's the Acura name and reputation worth? Acura must

Isuzu Rodeo/ Honda Passport

On paper, the Rodeo and the Passport are identical twins. The only mechanical difference between our two test vehicles was that the Passport had an antilock braking system (optional

450 is exactly the same as the Land Cruiser in powertrain specifications. The LX 450 has a softer suspension for a more cushy ride, and it borrows suspension pieces like the "rebound springs" in the front shocks from the flagship Lexus LS 400 sedan. But both

trucks are powered by the same 212-hp 4.5-liter dohc inline 6-cylinder and 4-speed automatic.

There are differences in trim. On the exterior, besides the Lexus grille and badging, the LX 450 wears unique ribbed body cladding, and upscale-looking 5-spoke wheels. Its interior has standard Lexus-grade leather and wood trim on the console.

The biggest difference between the Toyota and Lexus is the dealer. Lexus dealers are renowned for doing everything but massaging your feet. Lexus figures a few thousand people a year will pay almost seven grand more for such service.

And Ford's just-released full-size Bronco replacement, the Expedition, which comes standard with a 4.6-liter ohc V8, will also get a twin. This 9-passenger truck, which Ford hopes will steal buyers from both Suburbans, as well as from the Tahoe and Yukon, will have a double in Lincoln showrooms next year. It will be called the Navigator.

—S.O.



The Chevrolet Tahoe (top) and GMC Yukon have different names, that's all.

ELECTRONICS

**CANON
BUBBLEJET
BJC-4200**



**HP
NEWLETT
PACKARD Deskjet 693C**



**HP DESKJET
693C**



A DESKTOP 'PHOTO LAB'

New color printers and software turn your home into a custom print shop.

BY BRIAN C. FENTON,
Electronics Editor

LEXMARK
2050



• Home computers, color inkjet printers, scanners, paper, digital cameras and even photofinishers are on different roads, but they are heading in the same direction. They're all making it more fun than ever to take more pictures and share them with others.

"Greater picture utilization" is a phrase that camera and film manufacturers like to use. The more that people use images, the more they'll need cameras, and the

more they'll need film and prints. It doesn't matter if a lot of those pictures are taken with filmless digital cameras and printed on color desktop printers. It's still good for business.

Can a PC, a color inkjet printer and a floppy disk or CD-ROM really replace those shoeboxes full of photos that you have tucked in the back of your closet?

Traditional photographic technologies are alive and

well—healthier than ever, in fact—and are in no danger of being supplanted by personal digital imaging. But there's no question that home imaging will experience phenomenal growth over the next few years. How-

maker and a comic-book creator. A T-shirt designer, intended to be used with special iron-on transfer sheets, is also provided.

HP teamed with Disney to produce the *101 Dalmatians Print Studio* CD-ROM. Family projects include growth charts, banners, postcards, diaries, calendars and place mats. A second CD-ROM, the *HP Family Fun Kit*, includes everything needed to make refrigerator magnets, transparent window art and more.

Canon's BJC-4200 includes *Canon Creative 2*, a 2-disc CD-ROM set that goes even further to provide new applications for inkjet printers. It includes applications for creating cross-stitch and quilting patterns, and T-shirt iron-on transfers. *The Curious George Visits The Lake* interactive storybook for children is also supplied, along with the Design Essentials color desktop-publishing application, which offers templates for brochures, business cards, newsletters and more for the home office.

Interestingly the real power behind these printers is in their software drivers, which are designed to take maximum advantage of the paper and ink installed in the printers. Thanks to new photo inks and coated photo-printing paper, these printers can reproduce photographs with results that are surprisingly good—but they still can't match the resolution and color-reproduction of traditional photographic prints.

That's why Kodak—in collaboration with Hewlett-Packard, Microsoft and Live Picture—developed the FlashPix file format, which allows consumers to manipulate photos and create photographic compositions on their home PCs. But consumers can not only print quality images on their inkjet printers, they can also send them over the Internet to be printed on high-resolution digital photo-finishing printers.

FlashPix is a major departure from traditional image formats, which generally required powerful computers and a lot of

time to manipulate. Each FlashPix picture file is stored on-disc in multiple resolutions, each of which is subdivided into square tiles. It's not necessary to work with high-resolution image files to manipulate a picture on-screen. Instead, the image-editing software automatically chooses the appropriate version of the picture.

FlashPix images are treated as a collection of tiles, instead of a series of contiguous pixels, so many image alterations can be made much faster. When you enlarge the bottom right corner of a photo, for example, the computer doesn't have to read all of the data starting at the top left pixel. Instead, it can access the tiles in the bottom right corner directly, greatly speeding up operation.

Consumers won't have to invest in new computer hardware to work with



Microsoft's Picture It! is the first application that supports the new FlashPix file format and online print purchases.

ever, it will complement traditional photofinishing, not replace it.

Two technologies are making it possible for consumers to obtain photo-quality output from their PCs. Color printers are getting better and less expensive, and a new picture-file format called FlashPix will make it easier for consumers to edit and improve their images after snapping them.

Color printers represent one of the great bargains of the computer world. For example, the three printers shown on the previous pages can produce quality that would have been unheard of for a consumer printer just a few years ago. Yet, Lexmark's 2050 is priced at about \$250, Hewlett-Packard's 693C is \$349 and Canon's BubbleJet BJC-4200 is \$299. Each is bundled with fun software that takes advantage of its color capability.

For example, the *Lexmark Workshop* CD-ROM shipped with the 2050 includes greeting-card and certificate designers, photo-manipulation software, Internet-access software, a label



Microsoft's Greetings Workshop can import photo images that have been edited in Picture It!



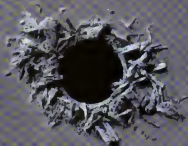
New color scanners, such as the \$229 Polaroid PhotoPad, make it easy to import existing snapshots up to 4 × 6 in. In size into PC applications.

photos, and they won't have to wait a few minutes when making changes.

Photofinishers will transfer a roll of film (24 pictures) to a CD-ROM for about \$20. A single photo can be transferred in full FlashPix resolution (1024 × 1536 pixels) to a floppy disk for about \$4.

New FlashPix-compatible software, such as Microsoft's Picture It!, make it easier than ever for consumers to crop and enhance their snapshots to create the photographs that they wish they had taken. More sophisticated software that adheres to the FlashPix standard will give consumers unprecedented ability to manipulate photographs with professional results. Not only will you be able to get rid of red-eye from a photo, as you can with Picture It!, but you'll also be able to eliminate wrinkles—or even your ex-wife. Who said that pictures don't lie? In the brave new world of home imaging, they'll say whatever you tell them to.

IT WON'T LET YOU CONQUER THE WORLD, BUT YOU CAN SURE BLOW THROUGH SUB-DIVISIONS.



*Dual speed settings for easy
drilling through most materials.*

*Single sleeve clutch for
one hand bit tightening.*



Heavy-duty steel planetary gears.

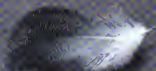


*On a single battery
charge you can give
600 screws the ride
of their lives.*



*The 2.0 amp hour EX CELL™ battery
means you can drive and drill longer.*

*It weighs 20% less
than competitive 14.4 volt
drill/drivers.*



The new Bosch 14.4 volt cordless T-handle drill/driver gives you unprecedented power and run time. It's lighter than the competition, too. Who knows, maybe now Rome can be built in a day.





HOME IMPROVEMENT

Hearth And Home

A homeowner's guide to gas fireplaces.

BY ROY BERENDSOHN, Associate Home Improvement Editor
PM Illustrations by George Retseck

● You're not alone if you want the look and feel of a crackling fire without hauling wood, cleaning up dirt, soot and ash, or worrying about chimney fires. Approximately 430,000 gas fireplaces were sold in the United States last year to people who felt the same way.

While there's always a strong case to be made for burning wood, hearth industry experts say that aging baby boomers are less likely to want to deal with firewood cutting, hauling and care. And they have less time to devote to wood-burner cleanup and maintenance. Besides, people who

Heat-N-Glo's pier-type direct-vent fireplace illustrates that there is a gas fireplace to fit nearly any design requirement. With these appliances, fire is visible from one to four sides.

live in comfortable, well-heated and energy-efficient homes are less likely to want more involvement—on any terms—with their home's energy system. What they want is a supplemental heat source and a cozy place to relax. And they've found it, right in front of a gas fireplace.

These units are available in a daunting array of styles and sizes, and most can run on propane or natural gas. They're also priced to suit a range of budgets. Generally, the appliances cost \$1500 to \$2500. Of

course, installation can greatly impact their finished cost. But even an installation cost of \$3000 to \$3500 is modest compared to the price of building a brick fireplace and chimney.

Fireplace basics

Gas fireplaces are quite different from the log sets, which have been around for years. Log sets are free-standing ceramic-log arrangements with a gas burner assembly underneath, and they are installed in an existing fireplace. Gas fireplaces, on the other hand, are housed in an insulated metal cabinet and can be installed nearly anywhere.

Inside these new fireplace boxes are ceramic logs and a burner assembly that deliver a reasonably realistic, woodlike yellow flame, instead of the short, nearly invisible blue flame associated with other gas appliances. This is surprising, because for years we've been told that a large yellow flame is a sign of incomplete and inefficient combustion. However, industry research has established that while the blue flame is optimal, it's possible to design a yellow-flame burner that's nearly as clean and efficient.

All gas fireplaces light with some type of automatic ignition, and most have a standing pilot. That is, they turn on automatically from a thermostat with the flip of a wall switch, the push of a button or by pointing and clicking a remote control.

Gas fireplace types

There are three basic types of gas fireplaces: direct-vent, top-vent and vent-free. Direct-vent fireplaces vent out the back of the appliance and through the house wall to the outside, while others vent out the top to the roof. They always use combustion air from the outside, and they vent exhaust gas to the outside using a pipe-within-a-pipe arrangement (shown) or two parallel pipes.

Top-vent fireplaces come two ways. One design is a fireplace insert. This type is installed in an existing masonry or metal fireplace, and it vents through the fireplace's existing metal or masonry chimney. The second type is a design that does not require an existing fireplace. It installs anywhere that codes permit the use of insulated pipe—called a B-vent—as a flue. This pipe has two walls separated by an air space and is used for exhaust gases only. The combustion air

for top-vent fireplaces comes from the surrounding room.

Typical direct-vent and top-vent fireplaces have ratings of 20,000 to 40,000 BTUs per hour (BTU/hr), although some manufacturers make large appliances up to 60,000 BTU/hr.

A vent-free fireplace has no exhaust vent. The gas is simply connected to the unit and the flame burns inside without a vent. The standards to which they are tested limit these units

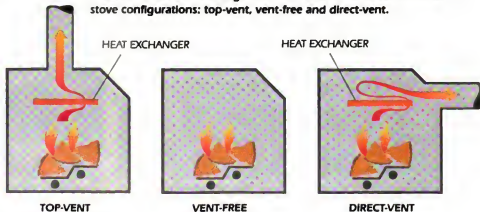
to 40,000 BTU/hr or less.

It's important to note that several states don't permit vent-free gas fireplaces. Building officials in these states have cited a conflict between the use of vent-free gas fireplaces and state building codes that require airtight, energy-efficient construction. A group of 20 fireplace manufacturers has formed a coalition to oppose this. They assert that vent-free appliances burn so cleanly that they don't pose a



How It Works

Gas fireplaces use ceramic logs positioned over a burner assembly to create a realistic yellow flame. Many of these appliances use a heat exchanger to increase their efficiency. We show a direct-vent model that pulls in room air, heats it and discharges it out the top grill. Note that the fire is separated from the heated room air. The appliance uses outside combustion air and discharges exhaust outside. Below are the basic stove configurations: top-vent, vent-free and direct-vent.



threat to indoor oxygen levels or air quality. They also cite the fact that vent-free fireplaces have an oxygen-depletion sensor that closes the gas valve if it senses a dangerous lack of oxygen in the room.

Efficiency

Nearly all manufacturers discuss efficiency when describing their appliances, but efficiency ratings can be confusing for several reasons. First, vent-free fireplaces are the most efficient in the sense that no heat energy leaves the living space in the exhaust. They convert nearly all the energy in the gas into heat that is transferred to the living space. Because of this, they're not required to have an efficiency rating, although manufacturers often say they are 99.9% efficient. On the other end of the efficiency spectrum, some of the new vented gas fireplaces are so inefficient that they may be designated for decorative use only, and thus have no efficiency rating at all.

Of course, some vented gas fireplaces are very efficient and are tested to the same standards as wall furnaces. They have two ratings: optimal steady-state efficiency and a federally required annual fuel utilization efficiency (AFUE). The AFUE rating is less than the steady-state efficiency because it accounts for efficiency reductions that occur in startup and for standby losses from burning the pilot light.

These two ratings can cause some confusion. So whenever you're comparing units, be sure that the efficiency that's quoted on each is from the same



Travis Industries' Fireplace Xtordinaire is an example of a flush-front, arched-top design. The direct-vent appliance pulls air into the lower grill, heats it and discharges it out the top. It's installed on a raised hearth, but it can also be installed at floor level.

rating system. Also, keep in mind that both vented and vent-free fireplaces have BTU/hr ratings. These refer to the energy value in the gas that enters the appliance in 1 hour. A BTU/hr rating is useful because it provides a rough idea of the appliance's heating capability. And it can also be used in combination with the steady-state efficiency rating to

match the appliance's size to the living space where it's located.

Design and cost

There are two means by which gas fireplaces deal with the heat they create. They either pull air in through the cabinet, heat it and discharge it back into the room, or they simply allow the heat from the burner to



Heat-N-Glo's Heat N' Cool combines a direct-vent fireplace and an air conditioner designed to cool an area up to 300 sq. ft. It comes with a wood hearth shelf and louvered surround.



Direct-vent fireplaces like Majestic's DV33 usually can be installed flush to the wall or in front of it using a surround, as shown. The appliance is only 11 1/2 in. deep.

Industry Sources

● Gas fireplaces are sold a variety of ways. If you have natural gas service, you might find gas fireplaces sold by heating and cooling equipment dealers. If you have propane gas service, call your propane distributor/appliance dealer.

Also, check your phone book's Yellow Pages for hearth product stores. The stores that sell and service wood, coal and pellet stoves often sell gas fireplaces as well. An advantage of shopping at hearth product stores is that you will probably have a chance to see the fireplace in action, in a furnished setting.

Finally, some home centers sell gas fireplaces. They also stock the fireplace surround materials, such as wood trim, marble and ceramics.

The manufacturers' products shown in this article are listed alphabetically.

- Aladdin Steel Products Inc., 401 N. Wynne St., Colville, WA 99114; 800-234-2508.
- Heat-N-Glo Fireplace Products, 6665 W. Hwy. 13, Savage, MN 55378.
- Majestic Products Co., 1000 E. Market St., Huntington, IN 46750; 800-525-1898.
- Superior, 4325 Artesia Ave., Fullerton, CA 92633.
- Travis Industries, 10850 117th Place N.E., Kirkland, WA 98033; 800-654-1177.

For more information about gas fireplaces in general, request the brochure *The Right Choice* (Publication No. B 50152) from the American Gas Association. Send a self-addressed stamped envelope to AGA, Attn. Public Relations, 1515 Wilson Blvd., Arlington, VA 22209.

For more information on vent-free gas fireplaces, write for the *Consumer Guide To Vent-Free Gas Products* (Publication No. 96-1). It costs \$1 from the Vent-Free Gas Products Alliance, 1555 Wilson Blvd., Suite 300, Arlington, VA 22209.

For the free brochure *Rediscover The Heart Of The Home*, send a self-addressed stamped envelope to Hearth Products Association, 1601 N. Kent St., Arlington, VA 22209, or call 800-835-4323.



Superior's vent-free Pure Heat gas fireplace can be installed nearly anywhere because it requires no exhaust venting. It employs catalytic combustion to reduce emissions to almost nil.



The Aladdin Steel Quadra-Fire Grand Bay fireplace insert offers 3-sided viewing and a contemporary design. Other gas inserts install flush to the wall surface.

radiate directly into the room.

A blower assembly and vents may change the look of a fireplace in a way that you don't like, but they can drastically improve its performance. Other design options are decorative in appeal. It's in these areas that the manufacturers seem to leave the traditional fireplaces far behind. Heat-N-Glo's pier design (\$2160), for example, has a 3-sided view, brass trim and can be installed with a shelf above it. The Travis Fireplace Xtordinair, about \$2200, demonstrates a flush-to-the-wall design with an arched top. And the Heat N' Cool is a flush fireplace combined with an air conditioner. It costs about \$3600, which includes the woodwork. It comes with a metal tile surround, but you choose the tile pattern and install it.

The Majestic Products DV33 is a direct-vent appliance that has a ce-

ramic burner, which is supposed to be more durable than steel-tube burners. It also turns on and off with a wall switch or an optional wall-mounted thermostat, and it costs about \$1200.

Vent-free products are found in roughly the same kinds of configurations as direct-vent models, but their location possibilities are far greater because they don't need a vent. Superior's Pure Heat uses a catalytic combustion process which, the company says, results in no measurable carbon monoxide in its emissions. It costs about \$2200 and the surround is an extra \$865.

Finally, if you're considering a gas fireplace insert, you still have plenty of design options at your disposal. True, the existing fireplace determines the insert's location, but the appliances themselves are quite varied. Aladdin's Steel contemporary

Quadra-Fire Grand Bay insert, about \$2100, projects forward to allow fire viewing from three sides. Other designs are installed flush to the face of the existing fireplace.

Comparison shopping and installation

You can walk into many home centers, buy a gas fireplace, take it home and install it. Just keep in mind that the installation of some of these units can be pretty complicated. Like any gas appliance, you must run a gas line to the appliance that meets building-code requirements. And with vented versions, a code-approved vent installation is also required. Of course, if you don't feel comfortable doing this work, consider hiring a professional to install your fireplace. Also, when comparing costs, be sure to account for the complete installed cost. **PM**

TOOL TECHNIQUES**Screwdriver Basics**

TEXT AND PHOTOS BY
ROSARIO CAPOTOSTO,
Contributing Editor



● Driving a screw should be among the easiest of all operations performed in the home or shop. However, if you don't have the right screwdriver, it can be one of the most frustrating. And while matching your driver to the screw is the first step, good technique and tool care also play their roles. Used correctly, this simple family of tools forms the basis for nearly every maintenance, repair and building project you'll encounter.

Screwdriver design

The basic screwdriver is comprised of four parts: the handle, shank, blade and tip (Photo 1). Although screwdrivers with wood handles are available, those with plastic handles are preferred because of their greater strength and lower cost.

Screwdrivers come in a number of sizes and tip designs that correspond to screwheads. Among the driver and screw types available, you'll find several cross-slot varieties including the Reed & Prince and Pozidriv designs, the square, recessed Robertson head and the star-shaped Torx pattern. However, the overwhelming majority of screws you'll encounter are either cross-slot Phillips-head or traditional slot-head (Photo 2). Therefore, a selection of drivers that handles both of these screw designs is essential for every toolbox.

Flat-tip screwdriver sizes are specified by the length of the shank and the width of the tip. In general, the longer the shank, the wider and

thicker the tip and, accordingly, the larger the screw that can be driven. Lengths commonly range from 1 to 12 in., with tip widths from $\frac{3}{16}$ in. to $\frac{1}{2}$ in. An assortment of about a half-dozen screw-

drivers—including small, medium and large lengths of varied tip widths—will be sufficient for most of the work you'll encounter. Phillips-tip screwdrivers come in five sizes designated by the numbers zero through four, and in lengths from 1 to 8 in.

A standard slot-head screwdriver has a flared blade for extra strength. This feature, though, can get in the way when driving screws in counter-bored holes. To solve the problem, cabinet- or parallel-tip versions are available (Photo 3).

For working in tight spaces, an offset screwdriver is the tool of choice (Photo 4). It is simply a steel rod bent at 90° at each end, with the ends ground to fit slot- or Phillips-head screws. Ratchet offsets are also available for faster driving. The ratcheting action is particularly handy because the tip does not have to be removed from the screw for each partial turn. Offset drivers generally feature a different-



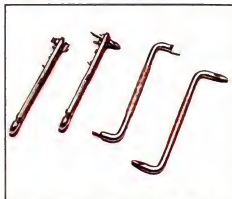
2 The most common screwheads and matching screwdriver tips are slot-head (left) and Phillips-head (right).



3 Wide blade of standard slot-head driver won't fit counter-bored hole. Cabinet-tip driver (right) handles the job.



4 Tight, confined spaces, such as inside a receptacle box, are best handled with a compact offset screwdriver.



5 Offset drivers (right) come in slot- and Phillips-head designs. Ratchet-type drivers (left) permit faster driving in tight spaces.

size tip on each end (Photo 5).

When you don't have easy access to the screw pilot hole, a screw-holding screwdriver is the solution (Photo 6). This driver has a gripping device at the tip so the screw can be positioned and driven with only one hand. Several types are available for use with slot- or Phillips-head screws.

Finally, when extra torque is required, a square-shank driver enables you to use a wrench to gain added leverage (Photo 7). Another way to amplify the torque at the driver tip is to wrap the handle with a cloth to increase leverage.

Using a screwdriver

To drive a screw, first twist it into its pilot hole with your fingers. Then, grip the handle of the screwdriver comfortably and firmly in the palm of your hand. With the thumb and forefinger of your other hand, grasp the shank above the blade to direct the tip into the screw's slot and to keep it from slipping out. Keep the screw and driver in line with the screwhole and intermittently rotate the handle as you reposition your grip (Photo 8). Gradually increase the torque as the screw advances into the work.



8 With one hand on the handle, use the other hand to hold tip in place. Keep screwdriver in line with screw and hole.



10 Screwdriver tip must be sized to the work. A tip that's too wide mars wood around countersunk flat head screw.



6 When the screw hole is inaccessible, a screw-holding driver is indispensable. Clips at end hold screw for starting.

When driving screws into wood, properly sized pilot and shank holes will ensure that the screw threads self-feed without requiring extra pressure on the screwhead. However, be sure to use enough pressure to keep the tip firmly locked in the slot. Of course, when you're driving very small screws the handle can be gripped and turned using only two or three fingers (Photo 9).

To most easily and effectively drive a screw home, it's essential that the screwdriver matches the size of the



9 Driving small screws takes less force and greater control. Hold screwdriver with one hand and turn with fingers.



11 A worn tip easily slips out of the slot and damages the screwhead. An under-size driver will also damage head.



7 Square-shank screwdrivers are best for high-torque driving. Use a wrench on the shank to turn driver.

SCREWDRIVER SIZE CHART

Slot-head drivers and screws

Blade size	Screw size
$\frac{3}{32}$ "	0 and 1
$\frac{1}{8}$ "	2
$\frac{5}{32}$ "	3
$\frac{1}{16}$ "	4 and 5
$\frac{1}{4}$ "	6 and 7
$\frac{1}{16}$ "	8 to 10
$\frac{3}{16}$ "	12 to 14
$\frac{1}{2}$ "	16 to 18
$\frac{1}{2}$ "	18 to 24

Phillips-head drivers and screws

Blade size	Screw size
0	0 and 1
1	2 to 4
2	5 to 9
3	10 to 16
4	18 to 24

Chart shows slot-head driver tip widths and matching screw sizes. Phillips-head drivers are designated by numbers.

slot or recess of the screw (see chart above). When driving countersunk flat head screws, a tip that is wider than the head of the screw will mar the wood around the head (Photo 10).

On the other hand, a tip that is too small won't provide optimal driving force and is prone to slipping out and damaging the slot. A tip that is rounded or misshapen will also slip and damage the screwhead (Photo 11). Once the screwhead is damaged, it may be impossible to remove the screw or drive it further.

Tuneup tips

To repair the worn tip of a flat screwdriver, grind it square on a bench grinder. Be sure to avoid overheating the tip so as not to draw the temper of the steel. To reshape the edges and faces of the blade, it's best to use a whetstone. This method provides better control and eliminates the danger of overheating the steel. Hone the faces so they're parallel and match the slot widths of the screws.

Homeowners Clinic

BY NORMAN BECKER, P.E.,
Contributing Editor
PM Illustrations by
George Retseck

Oil Burner Tuneup

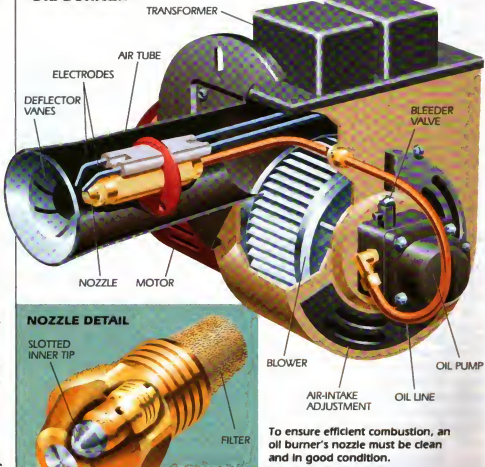
I have an oil-fired furnace, and I change the oil filter every other year. However, if an oil-fired furnace ignites properly and gets an adequate amount of fuel oil when it ignites, is there any point in installing a new fuel nozzle as well? Can anything else go wrong with a fuel nozzle in addition to dirt accumulation in its orifice? What is your opinion concerning the need for replacing a fuel nozzle on an oil-fired furnace?

JOHN R. SCHUT
HUDSONVILLE, MI

Homeowners often make the mistake of visually inspecting their furnace and concluding that it works properly and efficiently. But even an oil furnace that functions without generating an odor, puff-back or rumbling noises may not be operating efficiently. There are a number of variables that affect an oil burner's efficiency. Some of these variables are draft over the firebox, stack temperature, gas concentration, smokiness of the exhaust and the proper oil-spray pattern for the shape of the combustion chamber. Because of the complexity in addressing all these things, tuning up an oil burner is generally a job for a professional technician trained in oil-burner repair and maintenance.

The oil-burner nozzle, which di-

OIL BURNER



To ensure efficient combustion, an oil burner's nozzle must be clean and in good condition.

rectly affects the spray pattern, can have problems aside from dirt clogging its orifice. A nozzle can get overheated as a result of an improper burner-tube setting or back-pressure in the combustion chamber, and it can develop gum and sludge formations on the inside and outside. Nozzles have precisely ground slots in the inner tip, which cause oil to swirl as it is forced through the orifice. These slots can become coated

with sludge and gum, and in some cases it is practically impossible to see whether the slots are thoroughly clean without using a microscope.

A nozzle orifice is polished to a glasslike finish. If it becomes clogged and you try to clean it with a wire or pin, you can ruin the finish. This will cause streaks in the spray. Considering that a nozzle costs about \$10, I would certainly recommend replacing it every time the oil burner is tuned up.

Plywood Information

- We have always been proponents of going directly to the source to get the best information. In the case of plywood, that means contacting the APA, The Engineered Wood Association (formerly the American Plywood Association). If you work with plywood in building houses, furniture or just about anything else, the APA has a publication about it. To find out about all the technical data that the APA publishes, get its *Publications Index*. Just send your name and address to:

APA, The Engineered Wood Association, P.O. Box 11700, Tacoma, WA 98411.

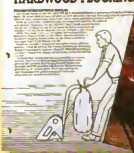
—Roy Berendsohn

Wood Floor Information

- We get a lot of questions regarding the care and repair of solid oak floors. The best resource we know of is the Oak Flooring Institute, a division of the National Oak Flooring Manufacturers Association. This group focuses primarily on solid-wood flooring, although many of its members make thin-plank flooring too. We show two excellent publications produced by OFI, but there are others on a range of topics, such as repairing a water-damaged floor, how to avoid floor shrinkage and installing a hardwood floor over concrete. Contact NOFMA/OFI, P.O. Box 3009, Memphis, TN 38173.

—R.B.

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Drivebelt Replacement

● Maytag dishwashers are dependable machines, but their drivebelts don't last forever. If your dishwasher is a few years old and it's starting to make unusual noises, such as a thumping or squealing, the chances are good that its drivebelt is worn out and should be replaced.

To check the drivebelt, turn off the power to the appliance and remove the access panel at the bottom of the machine, which is held in place with four screws. Once the panel is removed, look for the drivebelt, which goes around the drive motor on the right of the unit and the pump assembly in the tub's center. Reach in and turn either the pump assembly pulley or drive-motor pulley while rolling the old belt off the pulley. The belt is circular, not V-shaped, making it easy to remove and replace.

Buy a replacement belt at any Maytag service center or appliance parts store that sells Maytag parts. The part number is 902115, and it costs about \$10. Included with the belt is a small container of silicone grease, which must be applied to the belt before you install it. The grease prevents the belt from sticking to the pulleys.

To install the new belt, place it in the drive-motor pulley groove and stretch it over the pump-assembly pulley. Holding the belt in place, turn the pulley counterclockwise while rolling the belt over the pulley and into place. Reassemble the machine, turn the power back on and test run it. —Steve Toth



APPLIANCE CARE TIP

Ice In Attic

I have a problem inside my unheated attic. During the winter, frost and ice form on the attic roof. I have 6 in. of fiberglass insulation on the attic floor. The attic has two windows, and if I leave the door leading to the attic open, this seems to prevent frost and ice from forming. Is there a moisture problem? A new roof was installed about 12 years ago.

DONALD JOHNSON
WARREN, OH

The frost buildup on the underside of the roof deck in the attic is not a moisture problem, it's a ventilation problem. Moisture vapor rises into the attic from living areas below. Cooking, showering and the ground below the house all release moisture into the house's air. Even with a vapor barrier under the attic insulation, some moisture will always find its way up to the attic because it

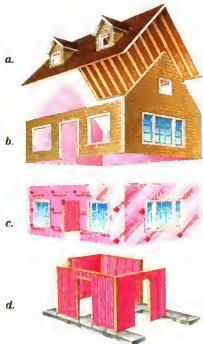
leaks through open joints or seams in the vapor barrier, cavities in walls or open sections around vent pipes or an interior chimney. The vapor enters the attic and condenses and then freezes on the roof deck. Over time, the moisture can damage the deck. In an adequately ventilated attic, the air movement will dissipate enough moisture so that frost will not develop on the cold surfaces.

You indicated that there are two windows in the attic. Are they closed? Quite often, attic windows are kept closed because they allow rain and snow to enter if left open. If the windows are open, are they located so that they provide cross-ventilation?

According to the Federal Housing Administration's minimum requirements for attic ventilation, the ratio of the total unobstructed ventilation opening to the attic floor area should not be less than 1:150, except when a vapor barrier is used on the

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attic floor, in which case the ratio may be 1:300.

If you are concerned that rain will enter the attic when the windows are open, you might consider replacing the windows with louvers or jalousie-type windows that deflect rain even when open.

Well Pump Cycling

I would like to know if it's normal for a well pump to go on about every 20 to 30 minutes. We bought our house one year ago. It was built in 1962, and it's been a good house otherwise.

LOUISE BROWN
SEQUIM, WA

Your pump should not be cycling that frequently. There are several causes of this, depending on the type of water system you have. The first thing to check is whether a slow leak somewhere in the plumbing system is causing the well pump to come on. Several likely sources for this are leaky faucets, shower heads or outside spigots. Leaky pipes may also be to blame. While these would generally be easy to spot because of the water damage they would cause, this is not the case if the pipes leak into a crawlspace. In this instance, the increased crawlspace moisture could also cause wood to rot and other problems, such as forming an inviting atmosphere for insects.

Another cause may be a leak in a toilet flapper or ball valve. This can be easily checked by inserting some food coloring or dye in the toilet tank. If the dye shows up in the bowl, you've found the cause, or at least a contributor to it.

If you have a submersible well pump, then another possible cause for the cycling condition is a leak inside the well casing. There may be a fracture in the plastic pipe or possibly a leak in the pump fitting. A leak within the well casing is an expensive problem to correct. Another consideration is whether the storage tank has become waterlogged (no air is left at the top of the tank). If it is, the pump will cycle whenever a small volume of water is drawn or leaks out.

Finally, with a very slow leak, an improperly set or malfunctioning tank-pressure switch will cause the pump to cycle more frequently than it would otherwise.

TM

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APPLIANCE CARE

Dryer Tuneup

BY STEVE TOTH, Contributing Editor; PM Illustrations by George Retseck

● If your dryer seems to take forever to dry a load of clothes, that doesn't necessarily mean it's time to buy a new machine. Chances are good that old faithful simply needs some attention. In many cases, a dryer that's not doing its job as quickly as it used to is suffering from an affliction that's quite easy to fix: lint buildup.

To work effectively, a dryer must move a large quantity of air over the clothes in the drum. The air is heated by a gas burner or an electric element and is pulled through the drum as it turns. Inside, the dry, warm air picks up moisture from the clothes and carries the moisture through a venting system to the outdoor air. However, moisture isn't the only thing that the air picks up along the way. It also accumulates lint particles from the clothes. That's why you need to clean the lint filter after each use.

Unfortunately, simply cleaning the filter may not be enough over the long haul. A small amount of lint can get by the filter and, over time, accumulate around the moving parts of the dryer and inside the ductwork and venting system. Not only does this accumulation restrict the flow of air, it can also pose a fire hazard.

Of course, the first step in ensuring safe and efficient dryer operation is to read and follow the manufacturer's instructions for proper venting proce-

dures. Use only approved venting material, such as rigid or flexible metal duct, to provide a minimal restriction to airflow.

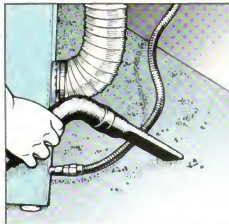
Don't use flexible plastic duct, which can be easily crushed or kinked. The ribbed surface of this type of duct is also more prone to lint accumulation.

To maintain good performance, all dryers should be cleaned at least once a year. To do the job, you'll need a good

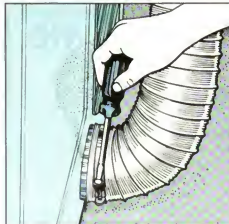
vacuum, a flashlight, a 1½- to 2-in. soft-bristle paintbrush, a broomstick or mop handle, an old towel, some duct tape and a few simple hand tools.

Start with the ductwork

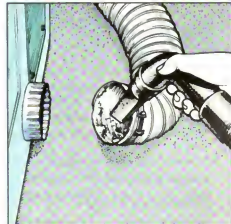
Begin by unplugging the dryer from its power source. If yours is a gas unit, shut off the gas supply to the dryer. Pull the machine away from the wall and vacuum all the dust and



1 After moving the dryer away from the wall, use a vacuum to remove any lint that has collected under the cabinet.



2 Disconnect the duct from the back of the dryer. It may be connected with screws, a clamp or duct tape.



3 Install a crevice tool on your vacuum hose and thoroughly clean the end of the dryer's exhaust duct.

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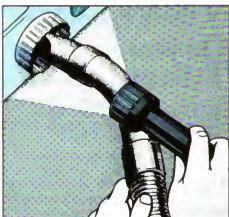
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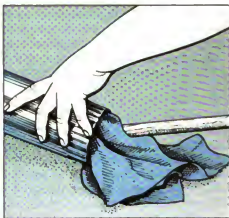
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4 Then move to the exhaust port at the back of the dryer. After vacuuming the lint, check the opening with a flashlight.

lint that's behind it (Fig. 1).

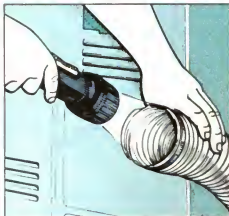
Then, disconnect the duct from the back of the dryer (Fig. 2). It may be secured to the exhaust port of the dryer with clamps, screws or duct tape. Use your vacuum and brush to



5 With the duct sections disassembled, use a broomstick and a cloth or towel to remove lint from the inside surfaces.

clean away all the lint you see at the end of the duct (Fig. 3). Then, move to the dryer exhaust port and clean the area with the vacuum (Fig. 4).

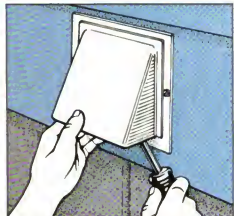
Next, disassemble each section of ductwork. Using the end of the



6 After wiping the lint from the inside of the duct pieces, inspect the sections to make sure that they're clean.

broomhandle, push a towel through each piece to remove lint buildup (Fig. 5). Then, vacuum and carefully inspect the inside of each length with the flashlight (Fig. 6).

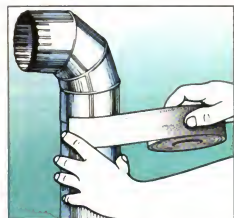
When the duct sections are clean, move to the exhaust hood that's mounted outside your house. The exhaust hood has a pivoting flap that opens when the dryer is working and closes when the dryer stops. The hood



7 Lift the hinged damper on the exhaust hood and clean the area inside. Make sure the flap opens and closes freely.

should be at least 12 in. from the ground. Sometimes lint can build up under the hinge of the pivoting flap, inhibiting operation. To clean the hood, reach inside and use a screwdriver to loosen any lint. Then, check that the damper moves freely (Fig. 7).

When reassembling the ductwork, avoid using sheetmetal screws to con-

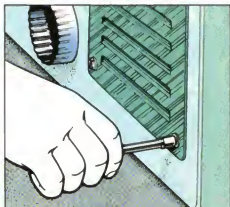


8 Reassemble the duct joints. Use duct tape on rigid sections and clamps on flexible duct. Avoid sheetmetal screws.

nect the duct sections. The sharp points can trap lint and accelerate accumulation. Instead, use clamps to rejoin flexible sections and duct tape to rigid sections (Fig. 8).

Cleaning the dryer cabinet

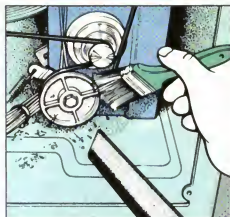
When the exhaust system is clean and assembled, start working on the front



9 To gain access to the inside of the cabinet, remove the service panel. On some machines, the panel is at the front.

of the machine. Remove the lint filter and use your vacuum's crevice tool to clean the space around and below the filter housing. Then, check the job with your flashlight.

It's also a good idea to check and clean the inside of the dryer cabinet and around the motor and drive assembly. To do this, first remove the service panel (Fig. 9). This panel is usually at the bottom front or rear of the cabinet. But on some machines



10 Use a paintbrush to loosen the lint around the motor, drive assembly, blower and heating unit. Then vacuum.

you'll need to remove the entire front panel to gain access.

Clean the internal systems with your vacuum and the paintbrush. Remove all the lint from the base of the dryer as well as from around the heating assembly, motor, blower assembly and idler pulley (Fig. 10). Again, use your flashlight to inspect these areas and make sure that all the parts are lint-free.

Reinstall the service panel and connect the duct assembly to the back of the dryer and to the exhaust hood. Then slide the machine back in place, turn on the gas valve (if yours is a gas unit) and reconnect the plug to the power supply.

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TOOL TEST

Sherline Metalworking Lathe

BY HERBERT KLENCK

• When the time comes to make that quantum leap from tape measure to micrometer, the machines you use will change too. However, you needn't jump in at the industrial level. For the hobbyist, modelmaker and those in need of small precision parts, downsized equipment makes more sense.

We recently tested a tool designed to meet such needs—the Sherline 4000A lathe. While it looks like a toy, it's capable of precision machining and boasts accessories that handle a full range of machine-shop operations.

This 3½-in. lathe has a 15-in. bed and comes with a 2½-in. 3-jaw chuck (Photo 1). For turning between centers, you get headstock and tailstock centers, faceplate and dog (Photo 2). The tool bit is locked in a block-type toolpost that fits in the cross slide (Photo 3). There's also a ½-in. chuck for the tailstock (Photo 4).

The motor has a variable-speed control that provides a range of 75 to 3000 rpm. Headstock features include lifetime-lubricated bearings, with adjustable preload to eliminate play, and a hollow spindle for handling long work. The headstock also rotates for taper turning.

Our tests show the 4000A to be surprisingly accurate. The runout of the 3-jaw chuck and spindle was measured at about .0002 in.—well within the limits demanded by precision turning. But, if you're accustomed to a bigger lathe, you'll find a few peculiarities. Because the cross slide is locked to the lead screw, moving the slide along the lathe bed is slow. We also found that positioning the large cross-slide table is tricky when working close to small pieces. For the modelmaker and home-shop enthusiast, however, these quirks are easy to get used to.

Accessories available for the 4000A include a vertical milling attachment, various toolrests and chucks, a steady rest, a compound slide and a power feed. The Sherline model 4000A lathe can be ordered from the manufacturer for about \$495. Contact Sherline Products Inc., 170 Navajo St., San Marcos, CA 92069.

PM



The Sherline model 4000A is a 3½-in. lathe that comes with everything you need for basic, small-scale precision turning operations.



1 A precision 3-jaw chuck comes with the lathe. The headstock spindle is hollow for handling long workpieces.



2 A faceplate and dog permit conventional turning between centers. The headstock pivots for taper turning.



3 Standard toolrest mounts on cross-slide table. Cross slide has adjustable gibs and moves on dovetail bed.



4 Standard drill chuck mounts in tailstock. Handwheels are graduated and anodized for easy readability.

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BY ROY BERENDSOHN, Associate Home Improvement Editor



Stick 'Em Up

Installing acoustic-tile ceilings is, in most cases, a lot easier when you use self-adhesive furring tape. Stick it to the ceiling, and then staple the tiles to the tape. The tape is 1½ in. wide and comes in 50-ft.-long rolls. It costs about \$13 per roll and is sold at Armstrong Building Products dealers. To find a dealer, contact Armstrong World Industries Inc., Customer Response Center, P.O. Box 3210, Lancaster, PA 17604; 800-233-3823.

Bells And Whistles

This home-security device does double duty. First, it's an infrared motion-activated 110-dbA alarm that mounts to a wall or stands on a shelf.

But it also has a much more pleasant-sounding chime function that you can set with the press of a button. It alerts you when company enters or a child wanders into an

area that's off-limits. Called the ProTector Mini, it's powered by four AA batteries and costs about \$15 at hardware stores, home centers and from the manufacturer. For more information, contact Alpan Inc., 425-I Constitution Ave., Dept. P, Camarillo, CA 93012; 800-972-2112.



Sticky Situation

Here's a vinyl-flooring system with a twist: one that uses an adhesive that you apply with a paint roller. Aside from making flooring installation nearly foolproof, it's also supposed to make it easy to remove. Just peel off the flooring and the adhesive comes off too, leaving the subfloor underneath clean. To install it, you cut the flooring to fit, then fold back about half of it. Roll the adhesive over the flooring's back and wait 10 minutes. When the adhesive becomes clear and tacky, press the flooring down and repeat the procedure on the other half. The flooring is available in 12-ft. rolls in a variety of patterns and colors, and it costs about \$16 a square yard. The adhesive costs \$15 a quart, which is enough to apply 24 sq. yd. of flooring. The products are sold at home centers. Contact Colmar Industries, 245 Butler Ave., Lancaster, PA 17601.



Get Your Backup

The Square D Generator Panel is designed specifically for backup-power applications. The service panel comes in 30- and 60-amp capacities, both of which can be fitted with two 2-pole circuit breakers or four single-pole circuit breakers. When the power goes out, you flip the



house's main circuit breaker to the OFF position and switch the Generator Panel's main breaker to the ON position. Fire up your generator, and you're back in

business. The Generator Panel's mechanical interlock prevents dual power flow into your house's electrical system when the power comes back on. It also prevents the danger of backfeeding power onto the power grid. The panel costs about \$320 at electrical supply houses and home improvement centers. Contact Inquiry Management Dept., Square D Literature Center, P.O. Box 1258, Waukesha, WI 53187.



Racing #35 (3 rotating designs)



Player #45

(4 rotating designs!)

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Soccer #79 (3 rotating designs)



Hockey #70 (3 rotating designs)



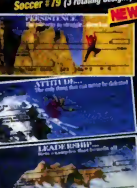
Football #75 (3 rotating designs)



Skiing #89 (3 rotating designs)



Equestrian #78 (3 rotating designs)



Inspirations #73 (3 rotating designs)



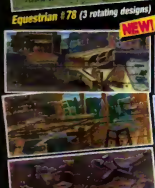
Medical #04 (3 rotating designs)



Dental #56 (3 rotating designs)



Firefighter #32 (4 rotating designs)



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TOTAL



More Power To You

It's not every day that you see a 12-amp motor on an upright vacuum cleaner. A motor that size is usually reserved for wet/dry shop vacuums. It's necessary on Jirt Devil's MVP vac because the appliance comes with a hose and telescoping wand that allows you to work up to 20 ft. away. The vac also has on-board tool storage, a control switch that stops brush rotation for cleaning hard surfaces and a high-filtration bag that the company says removes 99.97% of the particles from the airstream. Other features are a 32-ft.-long power cord and a ball bearing-mounted brush. It costs about \$200 at home centers. Contact Royal Appliance, 650 Alpha Dr., Cleveland, OH 44143; 800-321-1134.

Mission Control

If you're thinking of heating and cooling improvements, include Carrier's new electronic programmable thermostats in your considerations. They're designed to eliminate confusion, with simple instructions right



inside the door and features like a button for copying the previous day's settings. Data is stored in memory indefinitely in the event of a power outage, they don't require batteries, and they have a pushbutton feature that backlights the liquid-crystal display. And it's okay if you forget to change your furnace air filter now and then—the thermostat will flash a "change filter" message. There are three thermostats in the line, and they are sold through Carrier dealers. They range in cost from about \$150 to \$200. Write ACLS, Dept. 809-560/809-561, 318 First St., Liverpool, NY 13088, or call 800-422-7743.

Watts Up

Using a generator during a power outage can be a mixed blessing if the machine is loud, smoky and temperamental. Sears teamed up with generator manufacturer Generac to develop a product line with heavy-duty features for power backup as well as general use. For example, the line employs overhead-valve engines designed for clean and quiet operation using advanced pistons and camshafts. The engines have a spin-on oil filter and full-pressure, gear-driven lubrication with low-oil shutoff. They also have cast-iron cylinder walls and an automatic idle control to ensure durability. The machines range from 3250 to 8000 watts. The 4200-watt model shown (about \$900) is powered by a 7.8-hp engine. It has a 4-gal. fuel capacity and a half-load run time of 13½ hours. It provides four outlets spanning a range of 120 to 240 volts, and one 12-volt outlet for charging batteries. Visit your local Sears store for more information, or write Sears, Dept. 703, BC118B, Hoffman Estates, IL 60179.



Tough Break

The decorative light in this door looks like cut glass, but it's really a high-strength plastic-and-glass lamination that yields many benefits, according to its manufacturer, Pease Industries. The light is triple-glazed, consisting of an outside and inside piece of glass with a central resin-coated piece facing the outside.



This resin is molded to look like cut glass. The system is not only designed to be highly break resistant, but it also reduces sound transmission and screens out 99.9% of ultraviolet light. The unit is available in a variety of patterns for steel and fiberglass doors. They cost \$260 to \$380 at home centers and lumberyards. Contact Pease Industries Inc., 7100 Dixie Hwy., Fairfield, OH 45014; 800-883-6677.



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Chemistry Lesson

Polyvinylidene fluoride (PVDF) is not usually what comes to mind when one thinks about vinyl siding. Yet it's the basis of the improved weather-resistant properties that Alcoa claims for its PVDF-coated Lake Forest Premier line. The clear film is known for its toughness and weather-resistant properties, so applying it to vinyl siding seems like a logical thing to do. The siding is available in eight

colors that include blue, gray, tan and brown. It can be ordered with a contemporary vertical 5-in. double lap profile, a traditional 4-in. double lap and a 4½-in. Dutch lap profile. Its installed cost ranges from \$300 to \$400 per 100 sq. ft., depending on which region of the country you live in. It's available through Alcoa siding dealers. Write Alcoa Building Products, 1501 Michigan St., Sidney, OH 45365, or call 800-962-6973.



Gutter Talk

A skylight is a wonderful way to let in daylight, but installing one on a slate, tile or metal roof isn't exactly a picnic. Velux steps in to make the job easier with its new flashing system, known as EDW. It is designed to allow skylight installation over any roof material—even barrel-shaped clay tiles. It has substantial flanges that form a gutter, which directs water along the sides of the skylight and down the roof. The apron flashing conforms to the shape of the roofing because the flashing is made out of plastic-coated lead. This flashing system can be used on roofs ranging from nearly flat to those that slope at 85°. The skylight shown costs about \$184, and the flashing kits range from about \$75 to \$90. The skylights and flashing kits are sold at lumberyards and home centers. For more information, write Velux-America, P.O. Box 5001, Greenwood, SC 29648, or call 800-283-2831.



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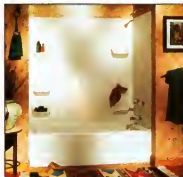
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Turnaround Time

If you want to put your bathroom remodeling job on the fast track, consider this bath surround system. Its manufacturer claims that it can be installed by an amateur in about 2 hours. It's made of a flexible high-impact polystyrene that attaches to a wall or tiled surface with latex adhesive. It comes in 1-, 3- and 5-piece models in 58- and 78-in. heights and in a variety of styles. Retail prices range from \$20 to \$200 at home centers. The tub surround shown costs about \$40 and the shower surround \$135. For more information, contact Design House Inc., W180N11691 River Ln., P.O. Box 1001, Germantown, WI 53022; 800-558-1919.



On Guard

Powered by a 9-volt alkaline battery, Flood Alert is a self-contained device that alerts you to a water problem. Mount it on a wall, or lay it on the floor near a sump pit. It sounds a loud alarm if rising water meets the contact prongs and closes the circuit between them. To make locating the unit easier, the prongs are mounted on a 12-in.-long sensor arm, and it has a low-battery warning beeper. It costs about \$22 at hardware stores or from the manufacturer. Contact Aquanot, 3680 Commercial Ave., Northbrook, IL 60062; 800-274-2682.



An Easy Fix

A gurgling, water-wasting toilet is annoying, but it can be easily fixed. Fluidmaster's improved flapper has the potential to make the repair nearly permanent because its plastic has been formulated to resist deterioration caused by chlorine. It mounts on a rigid plastic ring that is designed to provide a seal even if the tank's drain seat is eroded. Also, the device has a plastic timing cup that controls flush duration. The Flusher Fixer Kit costs about \$5 at hardware stores and home centers. Contact Fluidmaster, 1800 Via Burton, P.O. Box 4264, Anaheim, CA 92803.



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CAR CARE

CAR CLINIC

BY MIKE ALLEN,
Associate Automotive Editor

Hide And Go Leak

My car idles poorly and stalls a lot. The idle is inconsistent, and the exhaust smells like gasoline. At idle, I can hear a hissing sound, like a vacuum leak, but I checked the manifold vacuum and it's obvious that there is no vacuum leak. The manifold vacuum is 18 in. at idle—at least until the engine stalls. Where's the hissing sound coming from?

JOHN PELTIER
TALLAHASSEE, FL

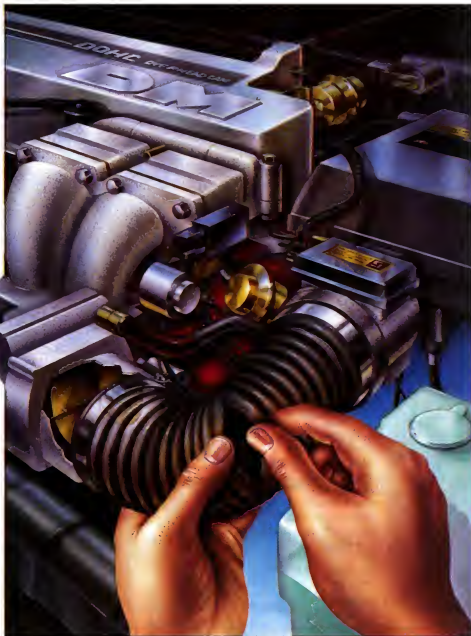
It sounds like a metered-air leak, John. Modern cars use an airflow meter of some sort to provide information to the engine-management computer about how much air is being burned on a millisecond time frame. This air meter is often located in unit with the throttle body or is mounted remotely, with air being ducted from the air cleaner to the airflow meter and then to the throttle body. Although air leaking into the duct between the airflow meter and throttle isn't a vacuum leak—and won't show as low vacuum on your gauge—it still affects performance. At idle, the leak can represent a large portion of the air ingested by the engine. The computer will know about only the air that passes through the airflow meter—and provide an incorrect amount of fuel to match. And your engine idles roughly and misfires.

Check the ducting between the throttle body and the meter. Look for splits, tears or loose hose clamps.

Locked Away

The transmission in my 1989 Corsica 2.8-liter V6 was acting up and stalling. I took it to AAMCO. The mechanic said it was the solenoid in the torque converter clutch. He said I didn't need it, so he disconnected it. The problem went away, but now at 60 mph the tachometer shows higher rpm than it used to. Please advise.

JOHN BUBARIS
WOODSIDE, NY



PM ILLUSTRATION BY DON MANNES

There's a clutch inside your torque converter. It locks up at a command from the engine computer to eliminate the normal slippage in the converter when you're traveling at higher speeds. This reduces engine rpm and wear, while increasing your fuel economy. The solenoid that actually applies this clutch is sticking on, and the mechanic "fixed" your problem by pulling the plug.

I would find a different mechanic who can determine whether it's a sticky solenoid or an electrical fault and fix it properly.

Let's Hope It's Not Really A Bomb

I recently replaced the rear brake shoes on my wife's Camry. I had the drums turned, but there's a click, click, click from the left rear at speeds below 20 mph. I thought it was a brake shoe that was not properly glued to the backing plate. I was told to try sanding the drums lightly with 320-grit sandpaper. I tried that twice, but it hasn't helped. Everything else seems fine. What's up?

NORWARD PITTMEN
GOLDSBORO, NC

CAR CARE

I'm assuming that there's no pulsation in the brake pedal, which would point to an out-of-round drum. If that's the case, then there has to be some interference between some rotating part—in this case, the brake drum—and some stationary part. It might be the new shoes or some part of the parking-brake mechanism. Pull the drum and look for shiny metal inside it where something has been rubbing. No luck? Try the following trick:

Remember carbon paper? (Remember typewriters?) Get a couple of sheets of old carbon paper and soak them overnight in half a cup of lacquer thinner. Use more of the lacquer thinner to clean the inside of the drum, including the center section, of all brake-pad dust and corrosion. Throw away the carbon paper, and use a paintbrush to paint the inside of the brake drum with the blue lacquer thinner. Use several coats to get a good blue surface to the

metal, although it's not necessary to coat the surface where the brake shoes drag. Wait a minute or two for the drum to dry, then reinstall it. Drive the car for a mile or two, and



Finger-Lickin' Good

● Just because most car manufacturers don't specify a regular change interval for power-steering fluid is no reason to think that it will last forever. Think about it—your power-steering pump is turning at speed the entire time the engine is running, and it does so in the extreme heat of the engine compartment. Many vehicles even have a cooler for the fluid. The pump has no filter, so wear particles and atmospheric dirt circulate constantly. Eventually, the hydraulic fluid will break down.

So whenever you check the fluid level (while you're waiting for the oil to drain at your regular 3000-mile change is a good time), go one step further. Stick your forefinger into the reservoir and get a sample of the fluid on your fingertip. (Be sure the engine is off and the fluid is not too warm, okay?) Smear it between your forefinger and thumb. If it smells burned or it has a lot of suspended particles, it's probably the right time to change it. If it smells really burned, there might be a problem with your steering.

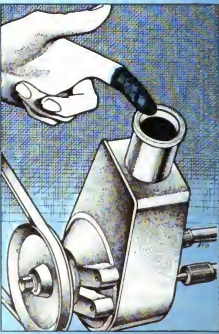


ILLUSTRATION BY ADOLPH E. BROTMAN

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CAR CARE

be sure you get it to make your noise. Then, remove the drum. You should see blue everywhere—except where the shoes drag and the source of your clicking. It should then be easy to properly position the offending part or at least file off the corner that's clicking.

Oil Crisis Bearing Down

I have a 1988 Chevy pickup with the 4.3-liter V6 and 98,000 miles. Starting about 10,000 miles ago, it showed 15-psi oil pressure at road speed and less than 5 psi at idle. I've always used 10W-30 oil, but changed to straight 30W at the last oil change. I replaced the oil-pressure sender, and now it reads 25 psi at road speed and doesn't drop at idle. Do I need a new oil pump or is there something else wrong? My mechanic says GM small-block oil pumps generally don't go bad.

RONNIE SKALA
TEMPLE, TX

Start by temporarily hooking up a mechanical gauge to confirm the readings on the electrical gauge. If they're accurate, then there's cause for concern. Thirty psi or more is correct. The general rule of thumb is 10 psi per 100 revs/minute. More significant is the sudden change in pressure. Your engine may simply be worn out.

SERVICE TIPS

- Mercedes-Benz will replace the electronic accelerator/idle control unit on C280, E320, S320 and SL320 models that briefly idle high after a cold start.
- Excessive resistance of the in-tank fuel-sending unit on 1994-95 Honda Accords keeps the fuel gauge from reaching the "F" mark. A new unit is available.
- Audi strongly recommends checking the differential oil (PN G052145 A1 or A2) level every 15,000 miles on all models with a 3-speed automatic transaxle.
- Your 1993-96 Jeep Grand Cherokee or 1994-96 Dodge Ram Truck needs a new heater-a/c check valve (PN 4677204) if it switches to the defrost mode on acceleration.
- Ford will rebuild the AX4N transaxle in your 1994-96 Taurus/Sable or 1995-96 Continental if it makes a metallic clicking sound when engaging Reverse.
- New valve-stem seals will cure constant spark knock and/or heavy oil burning on the 3800 V6 (VINs 1 and L) in many 1993-95 General Motors cars and minivans.

I'd start with an oil analysis, which will quantify wear metals in the oil. High quantities of iron could indicate a worn steel oil pump. High levels of lead and tin could mean worn bearings.

If either one of those signs appears, you can drop the pan and check the bearings and oil pump. It's simple enough to drop one or two main and rod caps, inspect the bearing shells and measure the crankshaft journals with a microm-

eter. I'd replace the main and rod bearings together with the oil pump if any one of them is worn out.

I would also make sure that the parts store had what I needed before going through the trouble of pulling the oil pan.

DO YOU HAVE A CAR PROBLEM?

Just ask Mike about it. Mail your question to Car Clinic, Popular Mechanics, 224 W. 57th St., New York, NY 10019. Letters, faxes, e-mail and phone calls cannot be answered individually, nor can their receipt be acknowledged. We'll choose the most interesting ones to discuss in this column.

As Heard On
Paul Harvey

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SATURDAY MECHANIC

REPAIRING PLASTIC BUMPERS

BY JOHN DECKER

● After you drove into the mall parking lot and saw how packed it was, you couldn't believe your luck when you spotted a space right next to the building. So you hurried into the space without noticing the extra-high concrete curb—until you heard your flexible plastic bumper strike it. To make matters worse, backing up in

a panic put a nice tear in the bumper.

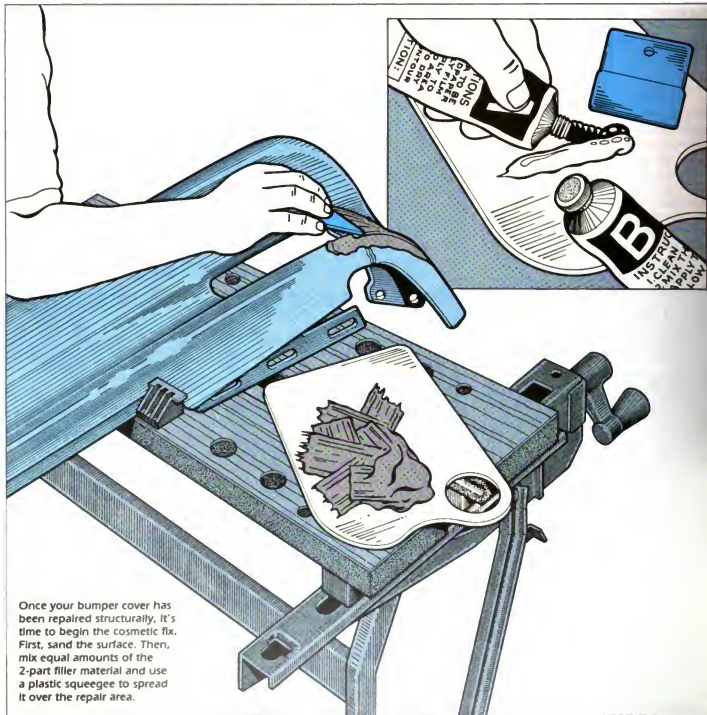
Oh well, there's no use crying over spilled milk. Thankfully, you don't have to cry over a split bumper, either. The 3M Co. makes a repair system designed to fix cuts, tears and abrasions in flexible bumpers. Once repaired, the bumper can then be painted its original color with an automotive

paint that has a flexible agent so it won't crack when the bumper flexes.

Velvet glove

All right, technically it's not really the bumper—it's the bumper's cosmetic cover. The true bumper/impact absorbing system is probably a metal

(Please turn to page 104)



Once your bumper cover has been repaired structurally, it's time to begin the cosmetic fix. First, sand the surface. Then, mix equal amounts of the 2-part filler material and use a plastic squeegee to spread it over the repair area.



Does this look like a good time to someone you know?

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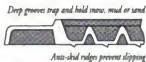


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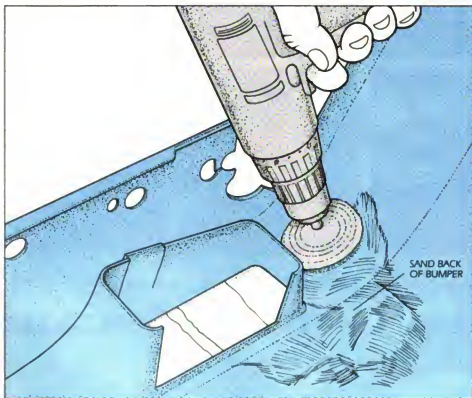
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Begin the repair by thoroughly cleaning and then sanding the broken part. Then, clamp it in its normal shape.

beam that is intended to do the real work. And if it's damaged, you'll need to replace the components with new ones to provide your vehicle with the correct crash protection. And don't

skimp there. However, the plastic skin isn't structural, despite the fact that it's the most expensive part of both the front and rear bumpers. Odds are that most low-speed mishaps

affect only the cover, and those can be repaired if you follow our directions.

The 3M P.R.O. flexible-parts repair system consists of a 2-part flexible filler that is mixed together (like epoxy), a flexible putty and a flexible coating that covers and seals the repair before painting. There's also an adhesion promoter that must be used on plastic parts made with polyolefins. Other items you'll need to make the repair include an electric drill, a 3-in. sanding disc with 36-grit discs, a random-orbit sander with 180-, 240- and 320-grit discs, a rubber sanding block, 240- and 400-grit wet/dry sandpaper, 80- and 120-grit sandpaper, a couple of body-filler spreaders and some method of spraying the coating. While a compressed-air spray gun is ideal, we've illustrated a small aerosol sprayer you can fill with liquid yourself. Pre-Val is one popular brand.

Stocking up

If you've done bodywork in the past, you'll be in good shape to repair these plastic parts. Most of the tools and the style of work is the same, but don't try to use the same materials to repair these flexible parts. The plastic is quite different in its adhesion characteristics from steel or fiberglass. Unless the part is prepped carefully, the

(Please turn to page 106)

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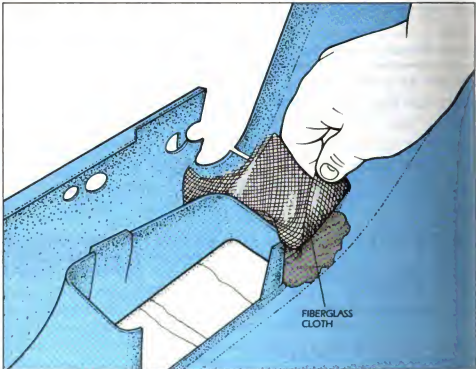


DISCOVER

repair materials will peel off within a few months, if not sooner. Because the plastic is quite flexible, ordinary body fiberglass resins, plastic body fillers and glazing putty will crack. Right now, the only manufacturer that makes appropriate repair materials is 3M, at least as far as we're aware. The car companies all recommend these products for their warranty repairs.

The products you will need are listed at the end of this story. To find a place that sells them, look in the Yellow Pages for an auto parts store that caters to the body-shop trade. It'll have paint and painting supplies. Sometimes you can find a paint store that also sells automotive paint and supplies. This type of establishment is used to dealing with professional body shop staff, not do-it-yourselfers, so don't expect to ask a lot of questions.

Most body-working materials are marked "For Professional Use Only." Not to worry, they're not Kryptonite. Use common sense and the same care you would with any epoxy resin or paint with volatile solvents and fine particulates. Avoid skin contact with the uncured resins. Work in a well-ventilated area or use an activated-charcoal painter's respirator to avoid inhaling fumes from the spray gun. Disposable respirators are priced very reasonably. If you plan on doing



Use fiberglass cloth and the special epoxy to reinforce the broken areas. Use your squeegee to work the resin into the cloth.

a lot of bodywork in the future, spring for a better one that uses replaceable activated-charcoal cartridges—it'll be cheaper in the long run. If you're sanding, wear a particle mask. The store that sells you supplies should have all of this equipment.

Plastic primer

It's possible to repair small cuts, holes, abrasions and other light damage without removing the bumper from the vehicle. However, if the cut is longer than an inch, or it extends to

(Please turn to page 108)

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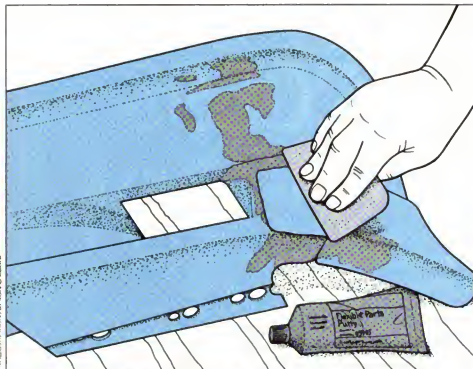
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The spot repair putty can then be used to fill in scratches, pinholes and small imperfections. It's easier to sand than the repair epoxy.

the edge of the part, you'll have to remove the damaged component so you can reinforce the back side of the-

pair with fiberglass cloth.

As noted above, most flexible bumpers are nothing more than

bumper covers backed up by other plastic components, a steel structure and collapsible bumper mounts. If you are unsure how to remove the bumper or how to remove the flexible cover from the bumper structure, consult a service manual.

A special adhesion promoter must be used between all the sanding steps on parts made with polyolefin. Therefore, you'll have to determine if the part you're working with is a polyolefin plastic before you begin. In many cases, the letter symbols TPO, PP, E/P or EPDM will be clearly marked on the inside surface of the plastic. Any of these indicate that it is a polyolefin plastic. If you can't find letter symbols on the part, sand the plastic with a 36-grit, 3-in. disc using a drill motor. If the plastic melts or smears, it's a polyolefin plastic. If it sands cleanly, it isn't.

Don't confuse pliable plastic body parts on or around the bumper with the sheet-molding compound (SMC) or fiberglass-reinforced polyester (FRP) parts commonly used on fenders and doors. These rigid, composite materials are identifiable by the fiberglass strands visible at tears or

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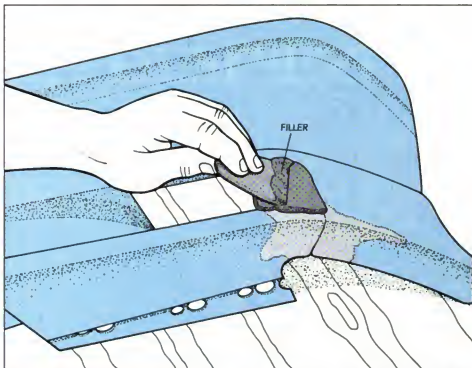
CAR CARE

holes, and they require a different repair method.

Getting started

Once you've determined the type of plastic you're working on, wash all the dirt and grime from the inside and outside of the part with soap and water. After the part dries, clean the area to be repaired with a specially formulated adhesive-cleaning solvent to remove any grease or tar. Be absolutely certain the area is completely clean—don't even touch the area with your fingers after it's cleaned. Use clean white paper towels, without any printed pattern, to apply the cleaner and to dry it off. Greasy shop towels, or any other source of contamination or oil, will prevent adhesion between the repair materials and the base plastic of the bumper, giving you at best a short-lived, sloppy-looking repair.

To reinforce the back side of rips, cuts, holes and tears, grind the back side of the area surrounding the damage with a 36-grit disc, making sure to leave a rough area of at least 1½ in. surrounding the damage. Don't grind all the way through the part. Just



Sand a "V" shape into the bottom of the crack. The repair epoxy can then be used to fill in the area. Wait for the resin to cure, then sand.

rough up the surface. Next, cut a piece of fiberglass cloth tape to fit over the area. Again, keep the area

and your hands squeaky clean. Leave the fiberglass cloth in its original packaging until you need it. Cut the

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cloth with clean scissors on a clean, grease-free countertop. Then, thoroughly mix together equal amounts of the 2-part repair filler. (If you're working with polyolefin plastic, spray the repair area with adhesion promoter and let it dry.) Next, use a plastic spreader to apply the filler to the area before applying the fiberglass tape. Once the tape is pressed down, apply filler to the top of the tape, using the spreader to force filler into the cloth.

It takes about 30 minutes for the filler to set thoroughly at 70° F, but temperature and humidity affect set-up time considerably. If you need to work in the winter, take the parts and repair materials into a heated area hours ahead of time to let them warm up. If you're forced to work outside, the temperature should be at least 65° F. At lower temperatures, the resins will take longer to harden, and they may never develop their full strength. If the part is badly damaged—say you're reassembling a bumper cover that's been broken into two or more pieces—it may be necessary to repeat the grinding/squeegeeing/cloth routine several times to achieve adequate strength. You may need to fasten the bumper cover down to something to hold the correct shape and alignment while the resins cure. Once they're set, there's no chance of realigning them—so work carefully. Because you're working on the back of the part, be thorough. You also need to take care while working around the areas where the bumper is bolted to the mounting to be sure it fits properly when you're finished.

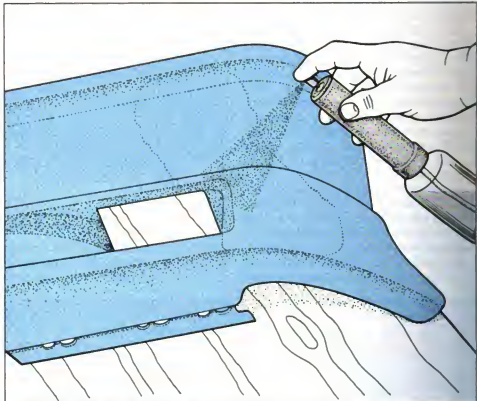
Once the reinforced area has set completely, check the stiffness of all the repaired areas and make sure the cover fits over the bumper. It may be necessary to repeat the preceding steps, adding one or more additional layers of fiberglass cloth to build up sufficient strength. Just be sure to roughen the surface with sandpaper to get good grip. Allow adequate time for each layer to cure before adding the next. Flip the part over, and use the 36-grit disc to grind about 1½ in. around the damaged area to remove paint and create a rough, tapered low area for the filler to adhere to. After grinding, featheredge the paint around the damage using the random-orbit sander and a 180-grit disc or a rubber-block sander. Featheredge for several inches surrounding the repair. Blow dust and debris away with an air hose. Squeeze out equal parts of the filler and mix it thoroughly. Use adhesion promoter on the polyolefin parts and

then spread the filler on the repair, taking care to leave it slightly higher than the surrounding area. If you've ever applied polyester body filler or glazing putty to a repaired steel body panel, you'll feel right at home.

Going for the finish

After the filler has cured, use 240-grit discs to sand the filler flush with the undamaged surface. Fill any pinholes

or other imperfections by applying putty with a plastic spreader. After waiting at least 15 minutes for the putty to cure, sand the surface with your rubber block and 80-grit paper to achieve a smooth contour. Sand out the 80-grit scratches with 120-grit paper. Then, apply a double wet coat of the coating material, and wait 10 minutes for the coating to "flash" dry. Then, apply a second coat. After 45



An adhesion promoter should be used to make sure the repair materials and paint will adhere. This is necessary with most plastics used to make bumpers.

Where To Find It

3M flexible-parts repair products are available at auto parts and body shop supply stores under the following part numbers.

Product	Part No.
P.R.O. Fill E-Z Sand; 2-part flexible-parts repair material	05895
P.R.O. Fill Putty; Fills scratches and pinholes in repaired bumper	05903
P.R.O. Bond Polyolefin Adhesion Promoter; Used on polyolefin parts after every sanding step	05907
P.R.O. Tect Flexible Parts Coating; Seals area after repair to prevent lifting and bull's-eyes after painting	05905

minutes of drying time, lightly scuff sand the area by hand with 320-grit paper, being careful not to break through the coating. The bumper is then ready to paint using color coats recommended for plastic body parts.

The painting operation will probably have to be done at a body shop, but you can prep the part by sanding its entire paintable surface with 400-grit wet sandpaper. Minor imperfections can be filled with more repair putty. The body shop will then have to prime it and spray it with a paint that has a special additive to make it slightly flexible.

If you're tempted to just touch up the panel in the affected areas with a spray can of aerosol touchup paint from the auto parts store, fine. Just remember that the panel is flexible, and the touchup paint won't last. In addition, it will be very difficult to feather into the existing flexible paint without leaving an ugly, low-gloss edge. **PM**

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Whether you're considering a career move or seeking ways to augment your present income. Whether you're a retiree, a recent graduate, or a hobbyist... you'll appreciate the unique approach of Foley-Belsaw's training programs. You gain skills quickly in your spare time at home; you can even earn cash while you learn! There's no

"classroom pressure"... no fierce competition... you set your own pace, your own study style. Foley-Belsaw also provides "extras" other courses don't offer: a 100% money-back guarantee; all the professional tools and equipment you need at no additional cost; and step-by-step instructions on how to start your own business.

...Choose from the following profitable fields:

1 LOCKSMITHING

It may surprise you to learn there's only one qualified locksmith for every 17,000 people in the United States. And as millions of Americans seek more protection from rising crime, locksmiths are now enjoying more business and higher profits than ever. Foley-Belsaw will make you a "pro" and also provide a course in Burglar and Fire Alarm Systems at no additional cost!



2 SMALL ENGINE SERVICE & REPAIR

Even simple repair jobs cannot be performed by the average small engine owner. With over 65,000,000 small engines in use across the nation (and that number grows by 1,000,000 each month), it's easy to see why small engine repair and service is a golden career opportunity. With specialized skills and knowledge you can earn as much as \$49.94 for a simple tune-up that will take about an hour of your time.



3 PROFESSIONAL SAW

...AND TOOL SHARPENING

Imagine a business where 90 cents out of every dollar you take in is cash profit! Best of all you work right at home; all it takes is a corner of your garage. Typical earnings are \$18-\$30 an hour and more... and you are in charge. Foley-Belsaw provides everything you need to master the craft, including your own professional Sharp-All machine.



4 VCR CLEANING, MAINTENANCE & REPAIR

With more than 77 million VCRs currently in use, VCR maintenance and upkeep is clearly a great career choice for the 1990s! And you need no prior experience for success. David K. Knowton, New York, tells us "I thought you had to be a 'wiz' in electronics to succeed in VCR repair. Nothing is further from the truth."



5 TV/SATELLITE DISH SERVICE AND REPAIR

You see them popping up in yards all over town. The market for satellite dishes will continue to grow to satisfy the demand for variety in entertainment. Get the skills you'll need to profit.



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6 PROFESSIONAL GUNSMITHING

Skilled gunsmiths - when you can find one - charge up to \$50 per hour for simple repairs. That's money you can put in your pocket with the training you'll get from

7 WOODWORKING

Although you start the Foley-Belsaw course with the simplest of projects, you'll soon be crafting mortise and tenon joints and creating heirloom-quality furniture that can translate into thousands of net-profit dollars. The course is also ideal for the do-it-yourselfer.



8 UPHOLSTERY

As furniture prices rise and quality noticeably decreases, more and more individuals and businesses are turning to skilled craftspeople to restyle and upholster furniture, much of which would have been discarded a few years ago. With the Foley-Belsaw course, you'll become an upholstery professional, utilizing your knowledge for a full-time career, part-time career, or a satisfying, money-saving hobby.



9 VINYL REPAIR

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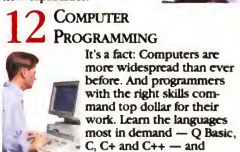
10 ELECTRICIAN

Start a business of your own or you can work for others. Your work is always in demand in either the commercial or residential field. Either way you can make top dollar as a trained electrician.



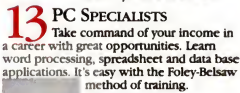
11 COMPUTER REPAIR, MAINTENANCE, UPGRADE

The personal computer today is the standard in businesses and homes. This course will provide you with the skills needed to handle the installation, maintenance and repair of new systems as well as the ability to upgrade older systems to new capabilities.



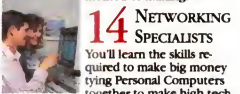
12 COMPUTER PROGRAMMING

It's a fact: Computers are more widespread than ever before. And programmers with the right skills command top dollar for their work. Learn the languages most in demand - Q Basic, C, C++ and C++ - and watch your income soar.



13 PC SPECIALISTS

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Air Filter

When not just clean air—but more of it—is desired, K&N's Filtercharger Injection Performance Kit for 1993-95 3.4-liter V6 and 5.7-liter V8 Chevrolet Camaros and Pontiac Firebirds is said to add 19.3 horsepower at the rear wheels. The manufacturer says



the kit flows 40% more air than the stock assembly, is emissions legal in all states and includes all emissions-control hoses and mounting hardware. The Filtercharger is \$345 at auto parts stores. For more information, contact K&N Engineering, P.O. Box 1329, Riverside, CA 92502; 800-858-3333.



Truck Cap Roller

Truck caps add a world of versatility to your pickup. Unfortunately, installing and removing them can send you truckin' to your local chiropractor. Truck Back enables you to roll your cap in and out of the bed in about 2 minutes. It uses a removable, lightweight fiberglass bed insert attached to a system of rollers and retractable legs. Models are available to fit conventional full-size caps, and the company plans to offer caps for compact models. The unit costs \$1150 and is sold by Truck Back Inc., P.O. Box 100, West Jordan, UT; 888-878-5225.

Electroplating Kit

To transform dull or corroded metal parts back to a brilliant luster, you can either send them out to a plating shop or replate them yourself. Eastwood's



Tin-Zinc Electroplating Kit gives you the replating works: container, electrolyte solution, low-voltage battery, anode bar, wire leads, gloves, goggles, polish and instructions. The kit will plate dozens of small parts of almost any metal, including brass, copper and steel. The kit costs \$69.99 and is available from The Eastwood Co., Box 3014, Malvern, PA 19355; 800-345-1178.

Impact Lug Socket

Ever change a flat and have the lug nuts roll all over the place, like dice on a Vegas gaming table? The Load-A-Lug is a 10-in.-long impact socket that internally stores up to 12 lug nuts

as they are removed. The spring-loaded retainer then ejects one nut at a time, as needed. A 2-piece socket set holds $\frac{1}{2}$ - and $\frac{3}{4}$ -in. and 19- and 21mm sizes. The set costs \$99.50, plus \$8 shipping and handling, from Big Lug Tools Inc., 137 Belle Ct., Oregon City, OR 97045; 888-244-5848.



Prostate Relief Naturally

It's a known fact. If you don't already have a prostate disorder and you're over 40, it's a two to one bet that you will by the age of 59. Most American men suffer from enlarged prostates by the time they are 65.

It begins with mild discomfort, but as the years pass, it can become disabling. The second most common surgery for men over 65 is prostate surgery. This surgery often causes loss of bladder control as well as sexual problems, including impotence.

The highly touted prescription drugs usually don't end the suffering, though if taken for a long period of time, they may halt the swelling. However, the side effects include a diminished sex drive and inadequate erections.

Many scientists feel that prostate problems can be deterred or the symptoms relieved by supplying the prostate with the nutrients it needs.

Important scientific research has demonstrated that you can safely relieve the problems associated with prostate malfunctions. The results of this research have been published in *The American Journal of Gerontology*, *The British Journal of Clinical Pharmacology*, and in publications of the National Cancer Institute.

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—Mr. D. Goris, Hawaii

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—Mr. W. Simms, Virginia.

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The most up-to-date formula containing the nutrients needed by the prostate is Pymoxin from S & G Laboratories. Pymoxin is a nutritional "safety net" for men who have or want to avoid prostate problems. Pymoxin contains *Serenoa serrulata* and *Pygeum africanum*. This team of powerful ingredients has been shown in rigid scientific tests to shrink swollen prostates.



Sidney L. Snow, M.D., a urologist, says: "An astonishing 80% of men will eventually get a prostate disorder. Prevention is the key. For many patients I see in my practice, the *Serenoa* contained in Pymoxin has led to significant improvements in nocturnal frequency, urgency and, even to some extent, potency functions."

The least expensive insurance against dreadful prostate problems is Pymoxin, which costs as little as a dollar a day. If you are not satisfied for any reason, you can return the unused portion within 30 days for a full product refund.

It's obvious why many men over the age of 40 are taking Pymoxin daily. For protection and relief, order Pymoxin today.

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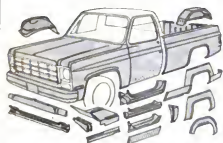
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